POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

Dow Styrene Boiler Plant

Electron Tube—Genie, Gremlin or Jeep?

Operation of Small Diesels

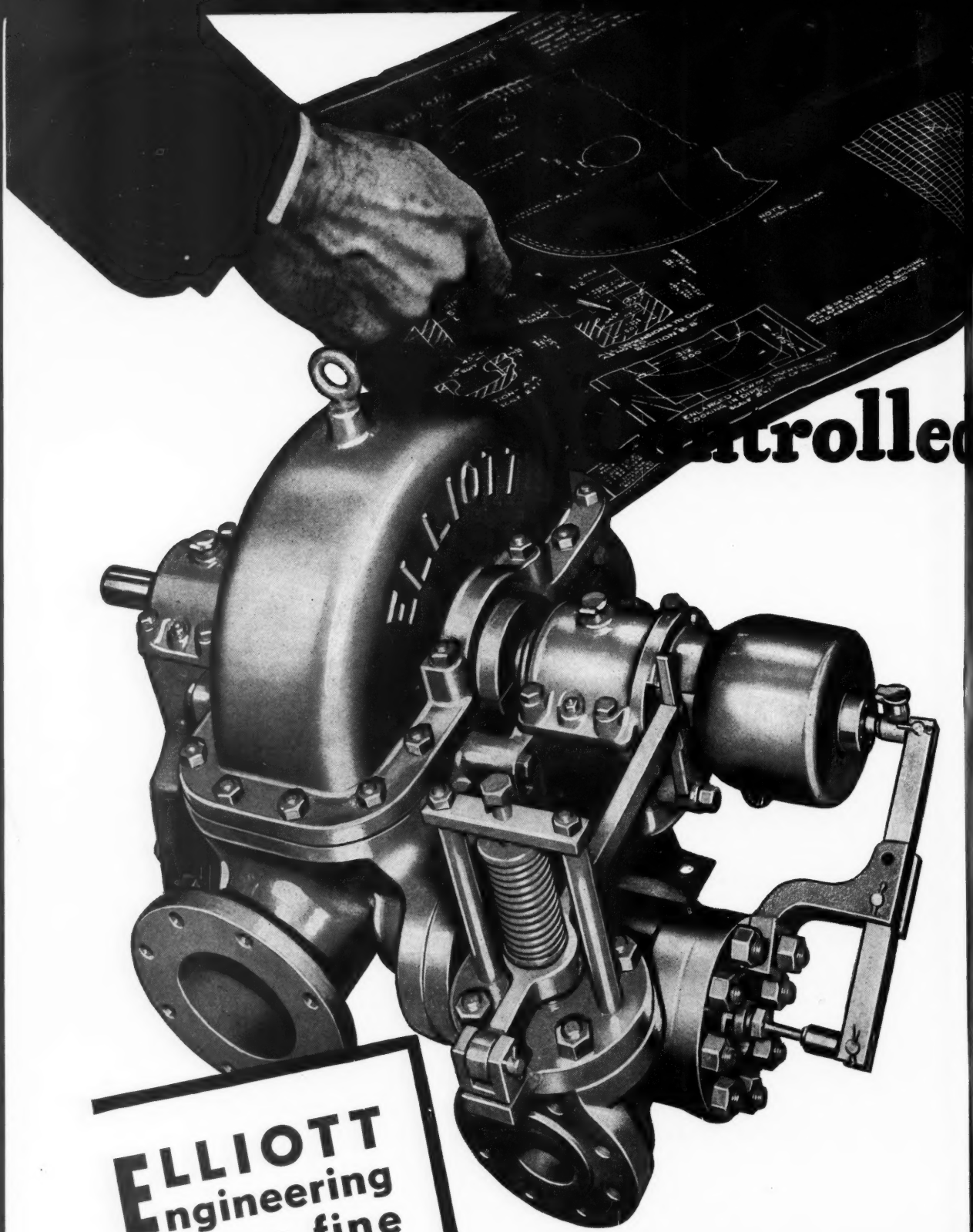
Power Factor Correction on Large Scale

Gas Turbines • Direct Contact Heaters

FEB 1 0 1944

FEBRUARY

1944



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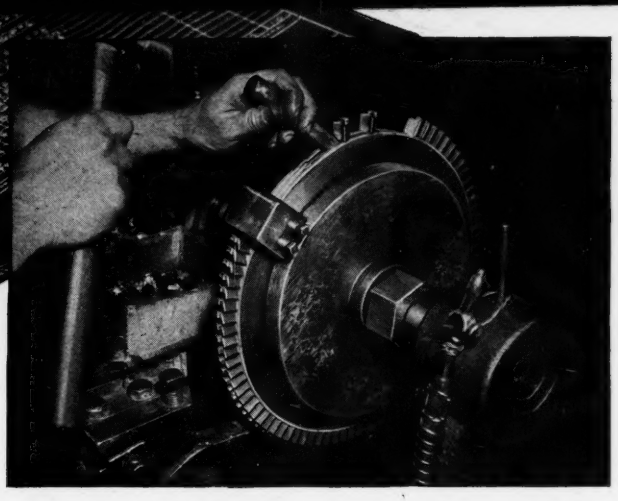


Driving turbine buckets into place on the wheel. Very close fit of buckets in their formed slot insures permanent tightness.

drive fit needed here – *make that tolerance .00025!"*

The fitting of turbine buckets is an exacting operation. Anything other than a permanent tight fit in the disc slot would result in vibration and eventual bucket failure. So Elliott engineers dictate a very close tolerance and special gauges for this detail. Pretty close work, and naturally real skill is required, but it is essential to the kind of performance expected of an Elliott turbine. This is the opinion of Elliott engineers — an opinion based not only on established standards but also on their many years of turbine-building experience.

The entire Elliott turbine is built with the same seasoned engineering judgment applied to dimensions, tolerances, materials, production methods, and other engineering features which affect ultimate performance. Certain design features are perhaps better than they need to be for small turbines, but many users want a turbine that needs no pampering, that will give uninterrupted service under any reasonable conditions (and some pretty unreasonable). They get such service from Elliott turbines.

The booklet about these turbines will give you very interesting factual evidence and data. It is valuable to have on file, even though you may not immediately need turbines. Write for a copy.

ELLIOTT COMPANY

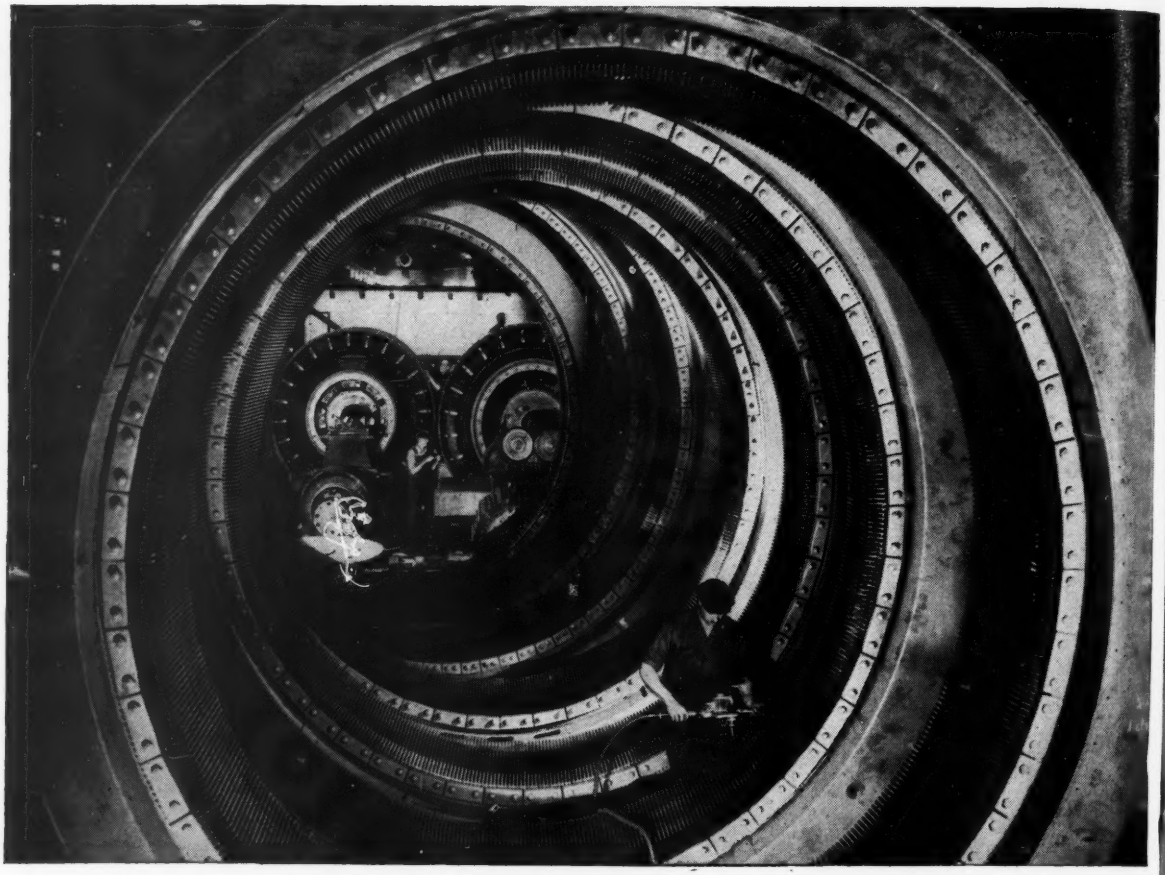
STEAM TURBINE DEPARTMENT, JEANNETTE, PA.

DISTRICT OFFICES IN PRINCIPAL CITIES

A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

H-676

URBINES for MECHANICAL DRIVE



Framing 54,000 hp.

AS these seven large slow-speed motors are placed in service, Uncle Sam will have an additional 54,000 hp. for his war effort.

The wartime use of motors of all sizes, together with heating and lighting, has produced the greatest electrical load in history. As an aid in carrying the load, power plants everywhere are lubricating Diesels, turbines and steam engines with Texaco.

In steam turbines, for example, *Texaco Regal Oils (R & O)* keep lubricating systems clean, bearing temperatures normal, governor action smooth and sensitive. They free themselves rapidly from air and water, and are highly resistant to gum formation and sludging. *They are rust and oxidation inhibited.*

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Huskier, *heavier* — 30 to 300% heavier, size for size, price for price — all Worthington "Feather* Valve" Verticals have the same rugged qualities as the big Worthington Air Compressors. "Feather* Valve" Radials have such special service-stretching features as airplane-type connecting rods and non-stop forced-feed lubrication. And both types have the famous trouble-free "Feather* Valve".

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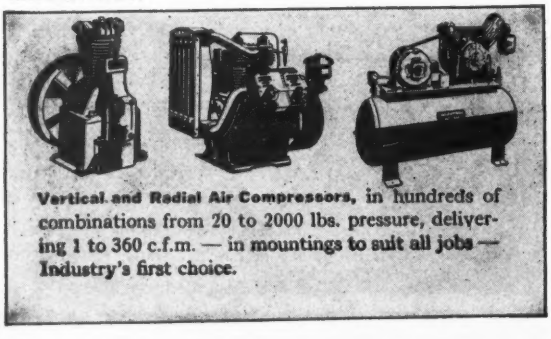
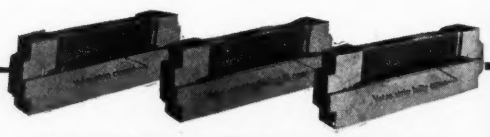


Vertical and Radial Air Compressors, in hundreds of combinations from 20 to 2000 lbs. pressure, delivering 1 to 360 c.f.m. — in mountings to suit all jobs — Industry's first choice.



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The "Feather* Valve" is the lightest, most efficient valve in use, simple in construction and operation . . . opens and closes by easy flexing . . . too light to develop destructive inertia . . . too flexible to warp. Simple . . . Foolproof . . . Dependable . . . Assures satisfying service and performance plus.

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WORTHINGTON PUMP AND MACHINERY CORPORATION
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FRONT LINES

GIMLET-EYED readers by the score—well, anyway, two or three—have expressed amazement at the great industrial news scoop recorded in Front Lines, January 1944, Page 7, Paragraph 2, Sentence 2. This stated that "five of the country's largest coal companies" are operating the new Port Neches butadiene plant. Obviously, it should have read "oil companies", since the five companies were named in the following sentence. We'll just pretend that we did this deliberately to find out how carefully people read our stuff. However, just to be on the safe side, we'll also administer 40 lashes to that miserable, down-trodden, white-collar slave of a proof-reader.

IN THE DESIGN of bolts and nuts, one factor is usually omitted from the formulas. That factor is a 250-lb fool with a 24-in. wrench and a 4-ft piece of pipe on the end of that. This comment was made many years ago and practical experience has impressed its truth on the minds of many an engineer. But with the introduction and widespread use of welding, there is sometimes a tendency to overlook the fact that a great deal of equipment still has to be bolted. It means something, therefore, to find J. O. Almen of General Motors Corp. Research Laboratories Division delivering a long and interesting paper on the strength of highly-stressed, dynamically-loaded bolts and studs before the recent annual meeting of the S.A.E. at Detroit. "The strength of most highly-loaded bolts and studs is determined by the man with the wrench and not by the designer," he says, "or by the metallurgist, or by the manufacturing process . . . A properly tightened nut is one that applies a tension load to the bolt or stud that is equal to or greater than the external load that is to be supported in service. When this condition is fulfilled and maintained against reasonably rigid bolted assemblies, the bolt cannot fail by fatigue because it can experience practically no change in stress regardless of the fluctuating nature of the operating load. It cannot fail statically because, to be tightened as specified, it must be capable of supporting the greatest operating load." Mr. Almen then continues with interesting test data on bolt fatigue and bolt stresses. Although his comments are directed primarily at automotive engineers, they are well worth the attention of all mechanical engineers and especially of power engineers.

TAKE ANOTHER LOOK . . . AND KEEP LOOKING . . . FOR SCRAP!

"BUT we've already turned in umpteen hundred tons of heavy scrap!" "We turned the place inside out the last time!" Through dozens of case histories of successful, continuing scrap campaigns run sentiments similar to those. Those, at least, were the sentiments at the dawn of the re-instituted campaign. Then—the campaign: the salvage official marshaled his forces, deployed his troops, and—lo, and behold!—more scrap and more—came forth. Have another look for yourself, won't you? A continuing safe scrap supply is Victory-insurance that America can't afford to do without.

SCRAP IS A MUST * *
DON'T LET IT RUST!

DELIVERY of metal products by means of the ocean tides was the idea behind an interesting story in a recent issue of *Steel*. Metal products, it appears, are being dumped overboard for the tides to carry ashore to our troops. The trick, of course, is in the packaging—with wax dipping playing the most important part. Some new hot wax dipping equipment for this purpose has been developed by the Aeroil Burner Co., West New York, N. J., to meet Army-Navy specifications for packaging for overseas shipment. If you are interested in anything of this kind, ask them for Bulletin No. 268.

OUR NON-ENGINEERING friends often ask us why it is not possible, with our present bombing technique, to knock Germany out of the war very quickly by destroying its electric power system. They think of the difficulties that arise even in our superlative electrical systems when a disastrous flood, a bad hurricane or some other great natural catastrophe occurs—of how utterly dependent we are on electricity. Well, let nobody think that the men who are directing our bombing operations have ignored this problem of putting Germany's whole electrical system out of business. A very interesting discussion of this is given by Brig. Gen. Edgar P. Sorensen, Assistant Chief of Air Staff, Intelligence, in the November 27 issue of the Saturday Evening Post, in an article entitled "We Pick the Targets for Our Bombers". His surprising conclusion is that the enemy's electrical system, except in conjunction with other vital industrial plants, is not a desirable target. To say it in another way, electric power targets are complementary rather than primary. If 90 per cent of German electric power facilities could be destroyed in one week, the results would be decisive, but obviously it is impossible to do it in as short a time as that. Piecemeal destruction spread over months would accomplish next to nothing. In fact, says General Sorensen, at the end of a year Germany might come up, as he is sure *we* would, with a better electrical system than before the bombing.

IN FABRICATING parts made of metals that melt at temperatures too high for die casting, or which present difficulties in forging, stamping or machining, and which are too complicated in shape for powder metallurgy, precision casting is serving the war effort with benefit and great promise. The foundry and the machine shop are, so to speak, joined in the one art. Tooling up expense is minimized, use of machine tool equipment lessened, saving in metal consumption frequently 50 per cent, saving in man-hours often 75 per cent. Tolerances vary with size, but very small castings may be held true within 0.002 of an inch. An expendable pattern, usually of wax or plastic, is made, from which a ceramic mold is formed. The desired metal is cast in the mold after the pattern is melted out. Either centrifugal force, vacuum lift, or air pressure "pack" the molten metal into the mold. Precision casting may point the way to the solution of significant engineering designs held back heretofore by the difficulty and expense of commercially fabricating intricate and complicated shapes. Private research of the process is widening, government has it under special study through the Office of Production Research and Development of WPB.

DEPT. OF LIBERAL EDUCATION in the House Organs in 15 Min. a Day. * * * Flame-Testing Lumber, showing methods used by Underwriters' Laboratories for testing wood treated with chromated zinc chloride to reduce its fire hazard when used as a building material; The du Pont Magazine, November-December 1943; E. I. du Pont de Nemours & Co., Inc. * * * Double Row or Duplex Ball Bearings, description of their construction and data on applications; The Dragon, November 1943; The Fafnir Bearing Co. * * * The Synthetic Rubber Story, one of the best complete descriptions of this new industry, with interesting photographs and diagrams; The Valve World, December 1943; Crane Co. * * * Human Understanding in Practice, a tribute to the splendid work of Miss Sarah M. Sheridan, on her recent retirement as vice president of The Detroit Edison Co.; Detroit Edison Synchroscope, January 1944 * * * Transformers for Ships, showing how they are built to meet this severe service, also Part III of Nineteen Basic U. S. Inventions, telling how simple electrical inventions, such as the telegraph, telephone and vacuum tubes, required the efforts of college-trained men, while complicated linotype and typewriter were invented by practical, mechanical men; Electrical Review, December 1943; Allis-Chalmers Mfg. Co. * * * Resonant Vibration in Large Engine Foundation, telling how vibration meters and sound analysers were used in analyzing vibrations due in part to an unusual soil condition; also Measurements of the Characteristics of Transmission Lines, Part II; General Radio Experimenter, November and December 1943; General Radio Company * * * Rubber from Haiti, A Battle Against Time, a program for developing rubber from cryptostegia, the project producing rubber only a little more than a year after it was established; Central Manufacturing District Magazine, January 1944; The Central Manufacturing District, Chicago. * * * The High-speed Diesel, Maintenance and Lubrication; Lubrication, December 1943; The Texas Co.

IF YOU have some technical problem that seems to warrant the services of an independent testing laboratory outside your own organization, do you know exactly how to find out where there is such a laboratory, equipped to do the type of work in which you are interested? If not, you will do well to get a copy of the recently issued directory of the American Council of Commercial Laboratories. This gives complete details regarding the personnel, testing facilities and fields covered by twenty-three commercial laboratories of this country, together with some interesting tables outlining their services by commodities. The executive secretary of this organization is A. J. Nydick, 63 Wall Street, New York 5, N. Y., who will doubtless be glad to answer inquiries.

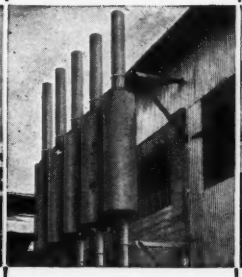
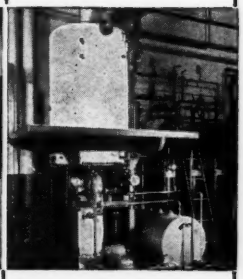
RECENT ANNOUNCEMENT that the film entitled War Department Report can now be secured for showing in industrial plants, reminds us that the War Department also has a large number of other interesting films designed particularly for war industry. Some of these are general in nature, showing actual battle scenes, both on land and in the air, and others are filmed for specialized industries, such as aviation plants, the lumber industry, the automotive industry, and so on. Full details of the films available and how they can be obtained may be secured from Chief, Industrial Services Division, Bureau of Public Relations, War Department, Room 2-E-867, The Pentagon, Washington, D. C.

THE JET PROPULSION airplane, one of our secret war weapons, has successfully passed all tests and is being put into full production, with much ado in the newspapers. Although the jet propulsion engine seems to be a great surprise to the general public, here again is another of these cases in which a development worked on by scientists and engineers for a comparatively long period suddenly bears fruit in a practical device. As most power engineers know, the jet propulsion principle has been discussed in the technical literature at various times during the past ten or twelve years. Full credit for the development of the jet propulsion engine and the plane it propels is given to the British. Its pioneer was Wing Commander Frank Whittle who began work on it in 1933 and had it in successful operation by 1937. In 1941 General Electric Co. began work on the engine and by March 1942 the first new engine was ready for testing in a plane built for the purpose by Bell Aircraft Co. It is known that the Germans have experimented with the jet propulsion plane. It may be presumed that a great deal of work will be done on it in the future.

RECOMMENDED Commercial Standards for Mineral Wool: Blankets, Blocks, Insulating Cement, and Pipe Insulation for Heated Industrial Equipment, No. TS-3633, dated January 7, 1944, is now being circulated among producers, distributors and users of these products for written acceptance. Anyone interested can obtain additional information and copies of the proposed standard from J. W. Medley, Division of Trade Standards, National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

THE RAPID TREND toward the higher speed Diesel engine and the equally rapid trend toward the use of smaller, high-speed Diesels in multiple installations in place of single, heavy, large, slow-speed Diesels, are two important factors that will accelerate Diesel engine use after the war, says John Dickson, Chief Engineer in charge of Development, Detroit Diesel Engine Division of General Motors. "I am convinced," says Mr. Dickson, "that post-war power will be the engines that have been produced and developed during the war and will not be radical innovations suddenly thrust on the users of the engines as untried and undeveloped projects."

EVERY TIME we see a reference these days to Mr. Leon Henderson, former boss of the OPA, we laugh long and heartily, but we have sometimes been puzzled to know exactly at whom we were laughing. Of course, we might have been laughing at his tavern-tenor rendition of "I've Been Working on the Railroad" on Information, Please the other night. But we don't think that's it. It seems that, when Mr. Henderson was in office, the principal criticism of him was that he was a former college professor and had numerous other ex-professors on his staff. Hence he was a wholly impractical man who knew nothing at all about the problems of business, he thought abstractly and dealt in unproved theory. The Milwaukee Journal, in a guest editorial in the Chicago Sun, reminds us of this and points out that Mr. Henderson's $12,000 salary as price administrator, the best he had ever received, was the clincher that proved he couldn't have much business sense. Mr. Henderson has been out of OPA for almost a year. He now holds four different jobs which pay him a total of more than $75,000 a year! We continue to laugh uproariously at somebody, but now we are convinced that that somebody is NOT Mr. Henderson.

PRODUCT	EXHAUST AND INTAKE SILENCERS	SPARK ARRESTOR SILENCERS	STEAM BLOW-OFF SILENCERS	HEAT RECOVERY SILENCERS
USE				
DESCRIPTION	● These Maxim Silencers are designed to silence the exhaust or intake of internal combustion engines, steam engine exhausts, air compressor intakes, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements.	● Maxim Spark Arrestor Silencers effectively silence exhaust noise and in addition provide for 100% trapping of all sparks and embers which might come from the exhaust. Of obvious value in marine use, these Spark Arrestors are also applicable to industrial use where a fire hazard exists.	● These silencers were developed for use on installations involving the discharge of high velocity steam, air or gas to atmosphere. Used for steam blow-off, safety valve discharges, etc. Silencers shown above installed on high velocity steam exhaust have a total capacity of 135,000 lbs. per hour.	● Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the recovery of waste exhaust heat to produce steam or hot water. Highly efficient heat transfer . . . automatic controls . . . may be run wet or dry.
LITERATURE	BULLETINS: D125, D127, D101, D37, D16.	BULLETINS: D105 and D33.	BULLETIN: D111.	BULLETINS: WH100, WH101 and WH103.

THE MAXIM SILENCER CO. • 89 Homestead Ave., Hartford, Conn.

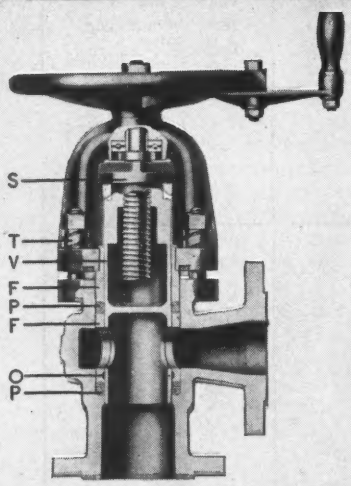
MAXIM

BLOW-OFF

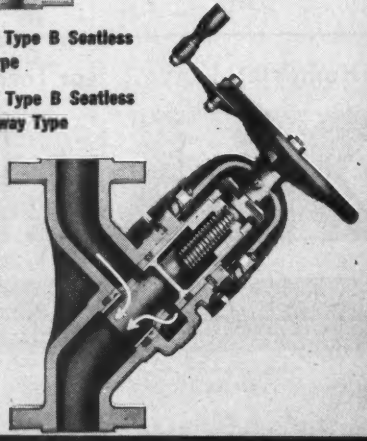
At left, Yarway Seatless and Double-Tightening Valves in Tandem, for pressures up to 250 lb

At right, Yarway Seatless Tandem for pressures up to 400 lb

FOR EVERY



1. Above: Yarway Type B Seatless Valve, Angle Type
2. Below: Yarway Type B Seatless Valve, Straightway Type



Yarway offers a complete Blow-Off Valve Service—FOUR DISTINCT TYPES OF VALVES to answer the Blow-Down Requirements of every steam plant.

Each is the product of more than a quarter-century of mechanical and metallurgical research—of practical field experience with more than 12,000 installations—of a determination continually to lead the Industry with the finest blow-down equipment that can be produced.

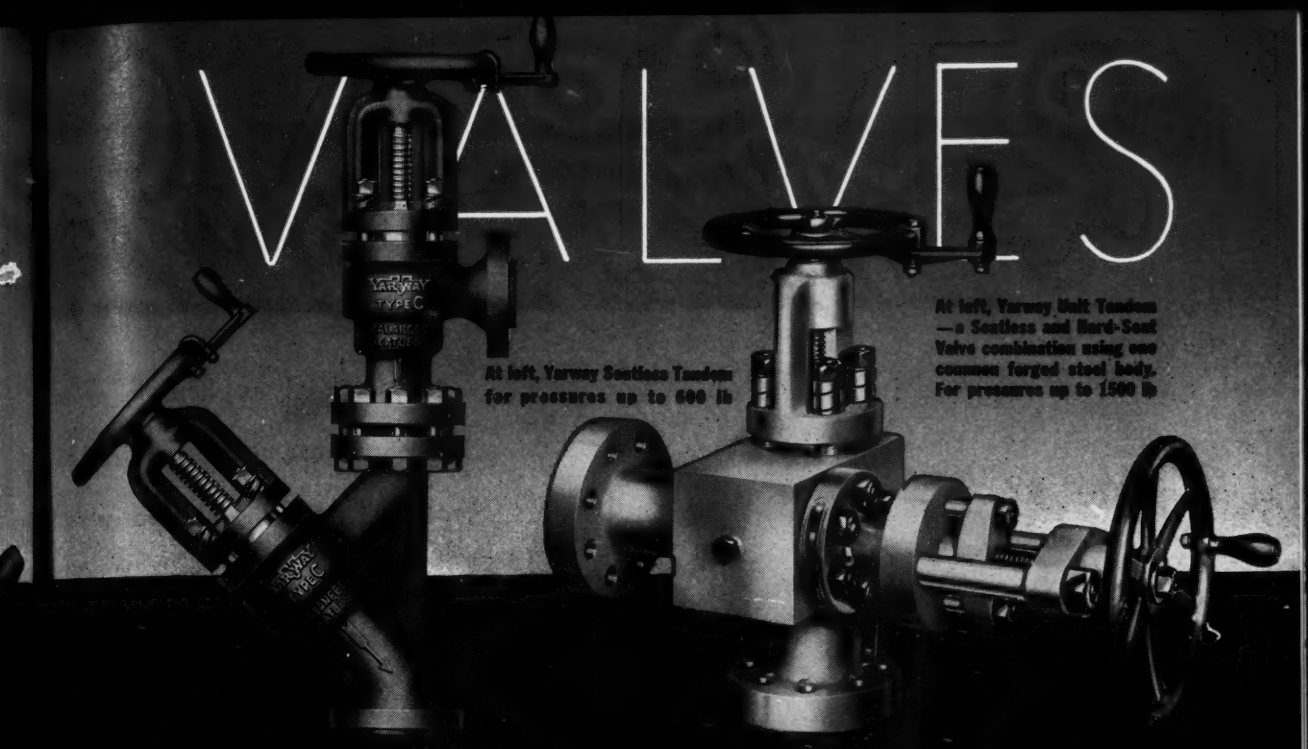
Because the Yarway line is complete you may be sure Yarway recommendations will be unbiased, based on honest judgment that the type valve selected will give long, trouble-free, money-saving service on the job.

Write for catalog; For pressures up to 400 lb, Section 422; For higher pressures, Section 431.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

VALVES



At left, Yarway Seatless Tandem for pressures up to 600 lb

At left, Yarway Unit Tandem —a Seatless and Hard-Seat Valve combination using one common forged steel body. For pressures up to 1500 lb

PRESSURE

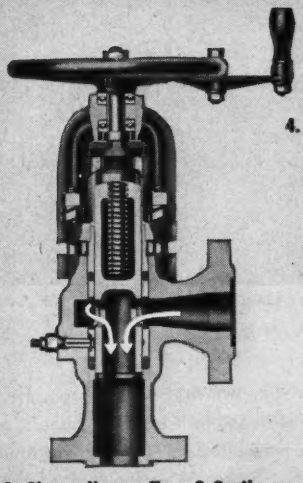
Yarway Type B Seatless Valves are of balanced, sliding plunger design. Made in Angle (Fig. 1) and Straightway (Fig. 2) Types. Operation of Yarway Seatless Valves: After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packings P, above and below port, making an absolutely tight valve. Yoke springs T maintain continuous pressure through follower glands F, on packing rings P. Annular groove O connects with alemite fitting for lubricating plunger and packing; alemite lubrication also provided for stem.

•

Yarway Type C Seatless Valves (Fig. 3) are made in both angle and straightway types. In this design the longer plunger protects the packing from blow-down at all times. Other features are laminated packing with stainless steel inserts, nitralloy plungers, alemite lubrication, ball thrust bearings.

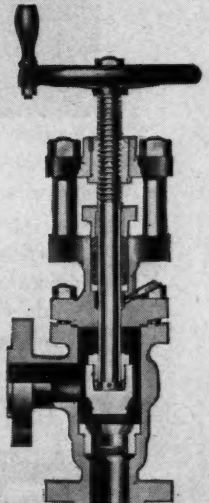
•

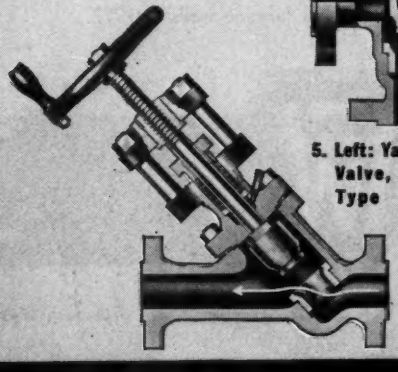
Yarway Hard-Seat Blow-Off Valves are of cone seat and disc type, having metal-to-metal contact. These valves are made in angle type (Fig. 4) and straightway easy flow type (Fig. 5). Features of the Yarway Hard-Seat Valve include: Marine and cast steel type yoke with threaded bushing, packing gland with bronze liner, large packing space, long-shank stem. Disc and seat ring are stainless steel; beveled faces have stellite inserts which provide smooth, hard-wearing surfaces at this important point.



3. Above: Yarway Type C Seatless Valve, Angle Type

4. Below: Yarway Hard-Seat Valve, Angle Type

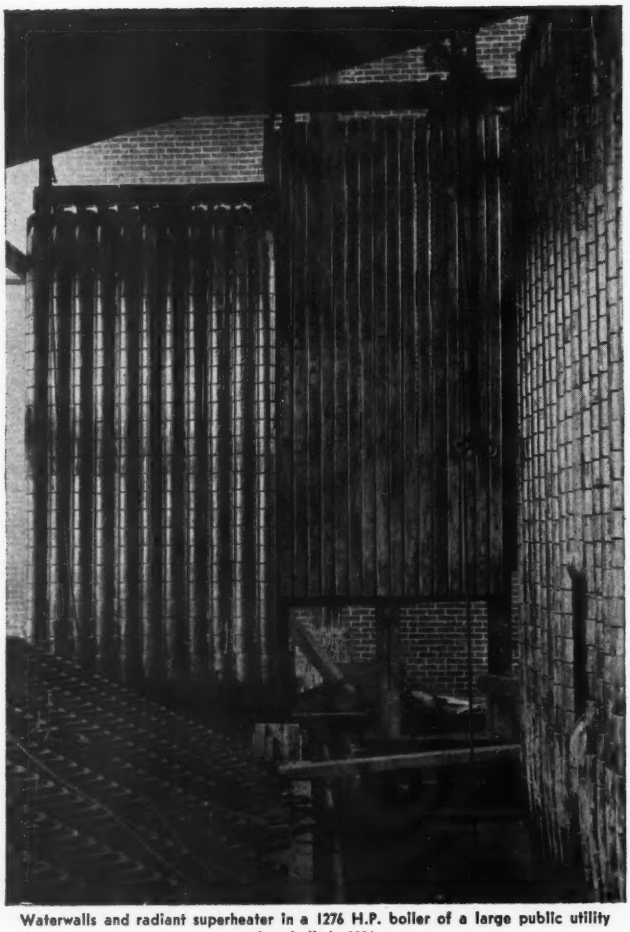




5. Left: Yarway Hard-Seat Valve, Straightway Type

BLOW-OFF VALVES

Blazing THE



Waterwalls and radiant superheater in a 1276 H.P. boiler of a large public utility plant built in 1926.

● It is well known that with improved combustion methods and the increase in the size of boilers, higher furnace temperatures resulted in prohibitive maintenance costs on brickwork. Foster Wheeler tackled this problem and was among the first to replace refractory walls with water and steam cooled surfaces, making the first installation of water cooled furnace walls in 1922.

● Intelligent application of eng
neering fundamentals, motivated
research, and tempered with t
"know how" of long experience co
stitute the keystone of progressi
engineering. Through the yea
Foster Wheeler has successfully a
plied this formula; thereby contribu
ing in no small measure to significa
advances in steam generator desig
Three examples prominent in univ
sal service are the "individual"
ternal economizer, radiant ty
superheaters and water-cooled f
nace walls.

FOSTER WHEELER CORPORATION

165 BROADWAY

NEW YORK 6, N. Y.

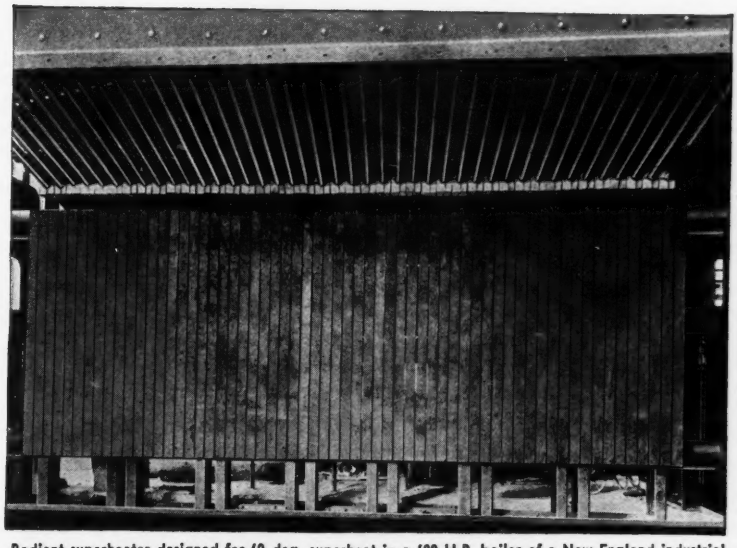
FW

FOSTER

ENGINEERING TRAIL

● To utilize the high heat transfer rates of radiant heat in furnaces and the protection which steam cooled walls afford refractory, Foster Wheeler developed and installed the first radiant superheater in 1917. This advance in furnace practice was the forerunner of combination superheaters which insure constant final steam temperature over wide fluctuations of load.

Foster Wheeler is a Three-Star winner under the U. S. Navy Board of Awards for production.



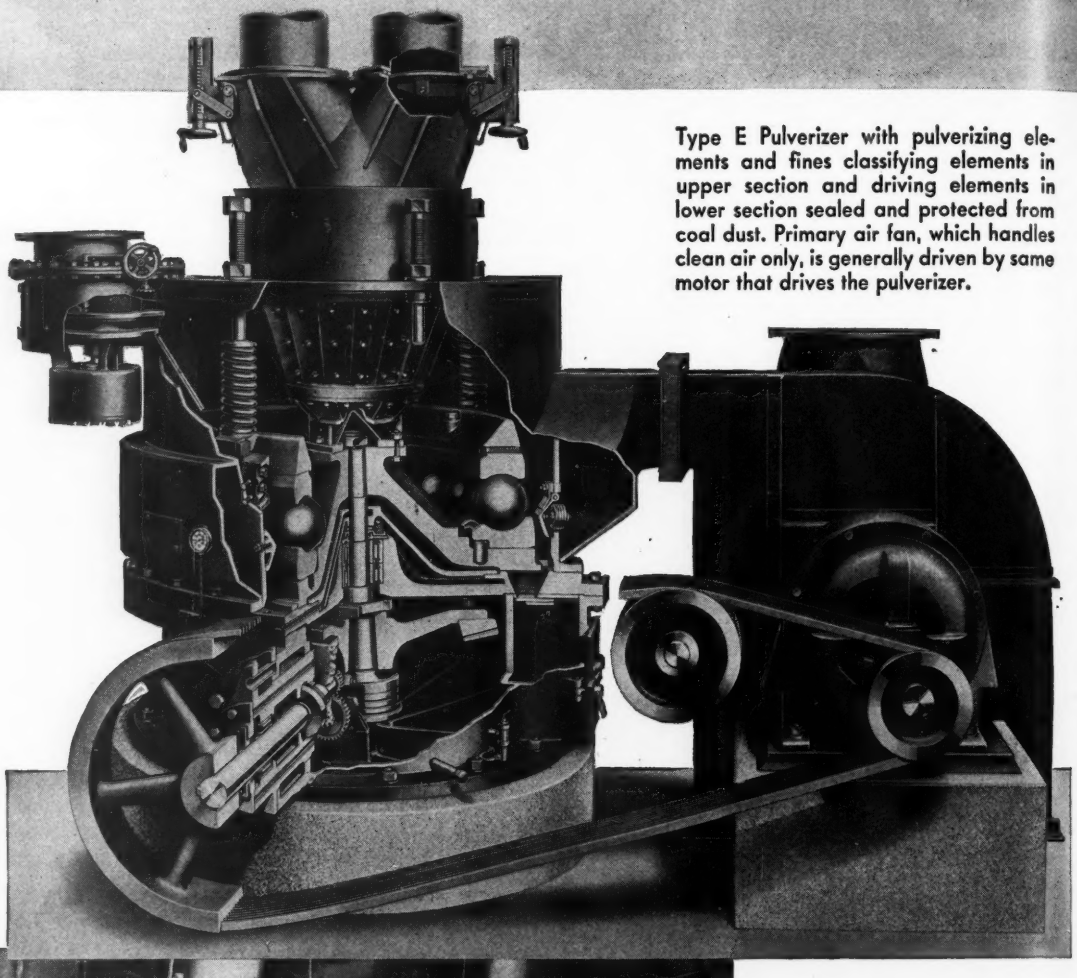
Radiant superheater designed for 60 deg. superheat in a 600 H.P. boiler of a New England industrial concern. Installed in 1925.

3416 sq. ft. extended surface economizer installed in 1925 in a Mid-western industrial plant.

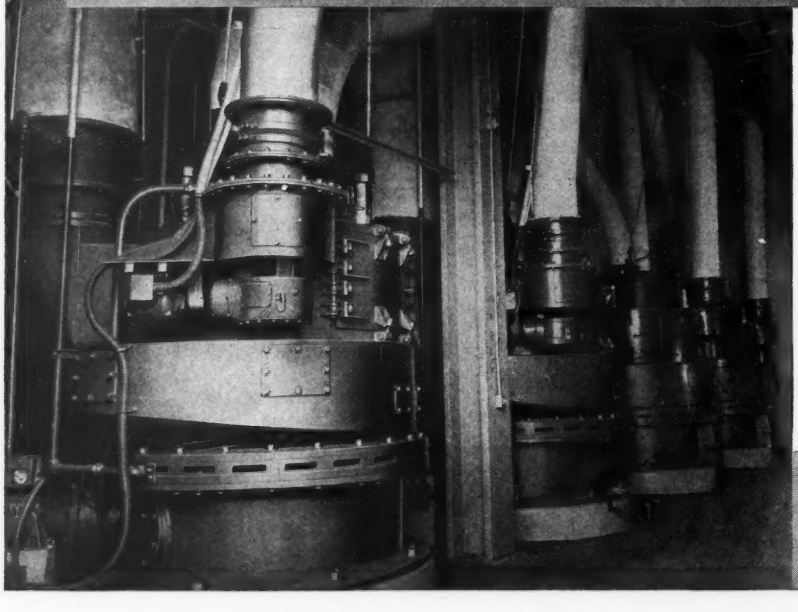
● Today the vast majority of large steam generators are equipped with individual economizers. Twenty-four years ago that was not the case—it was then that Foster Wheeler installed the first extended surface, forced water flow, high pressure, high gas velocity economizer as an "individual" unit to service one boiler. This economizer was deliberately designed for high draft loss on the economic principle of maximum work from minimum economic surface. Foster Wheeler has installed more than 4,500 extended surface units—indisputable proof of superlative performance.

WHEELER FW

The B&W



Type E Pulverizer with pulverizing elements and fines classifying elements in upper section and driving elements in lower section sealed and protected from coal dust. Primary air fan, which handles clean air only, is generally driven by same motor that drives the pulverizer.



Over 400 Type E Pulverizers are in service or on order for direct firing boilers. Individual installations have as many as 16 units.

Type E Pulverizer

Fits into Any Day's Fuel Picture

Operates reliably and effectively in direct-firing pulverized-coal systems

By every standard of direct-firing pulverizer performance, the Type E Pulverizer fits into the fuel economy picture any day, and especially so during the present emergency requirements.

Type E Pulverizers—

Are reliable in service and low in maintenance, as measured in service hours before replacement of parts becomes necessary.

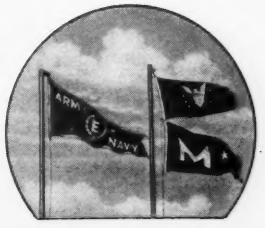
Respond readily to load changes—output controlled at one point, the primary air damper, and are adoptable to fully automatic control.

Maintain fineness and capacity throughout life of grinding elements.

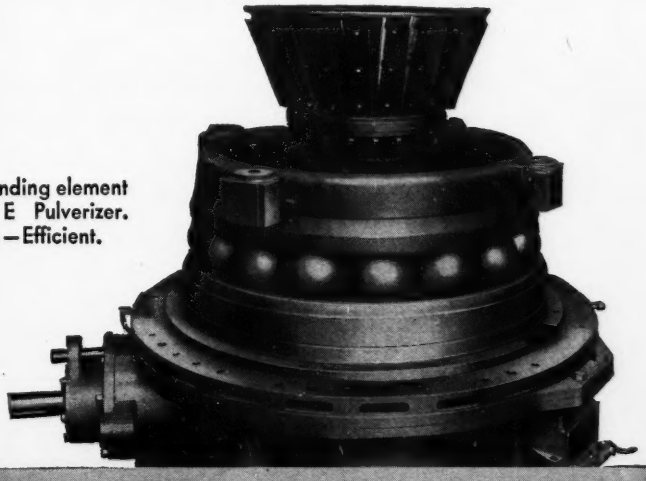
Handle coal of a wide variety and, due to drying in the mill, can handle coal with as much surface moisture as it will carry.

These and other features of the Type E Pulverizer are given in more detail in Bulletin G-30-A. Copies obtainable on request.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK, N. Y.

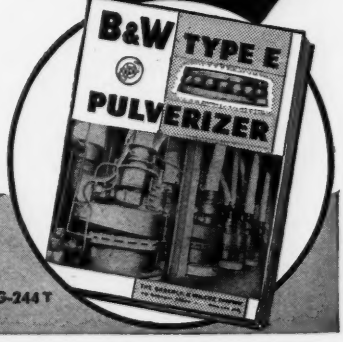


The Army - Navy "E" and Maritime Commission Award flags are floated proudly at the plant that builds Type E Pulverizers.



Ball-bearing grinding element of the Type E Pulverizer. Simple – Sturdy – Efficient.

For a copy of this bulletin return this pasted on a penny post card with your name and address.



BABCOCK & WILCOX G-244T

Official U. S. Navy Photo

Violent Sea Action!

"Sure Kill" of a Nazi sub is depicted in this remarkable close-up of a U.S. bomber attack against a Nazi wolf pack. One bare-legged Nazi stands in awe as another ducks. Arrow points to depth bomb about to hit water.

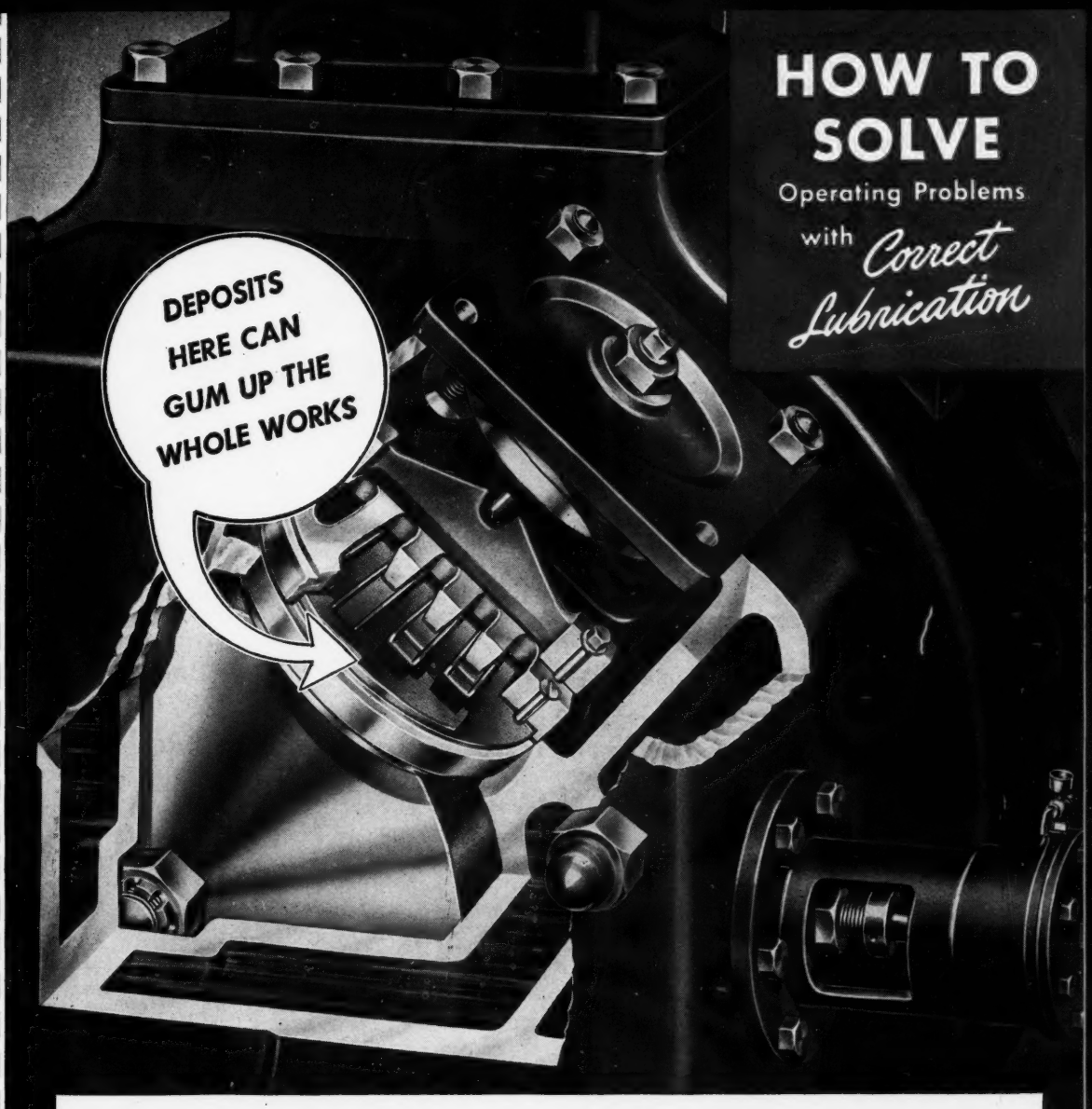
Buy more War Bonds and help kill the enemy wolves!

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Photo at left shows a set of Garlock **CHEVRON** packing and a single Chevron ring. Chevron is one of the many Garlock packings being supplied to the U.S. Armed Forces and war industries.

GARLOCK

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION



HOW TO SOLVE

Operating Problems with *Correct Lubrication*

Keep these valves clean!

THIS IS A "HOT SPOT"—and a danger spot—in air compressor operation. If oil oxidizes and forms carbon deposits here—in the valves—it can cause high discharge temperatures with dangerous consequences.

To prevent this, you need oils that have high chemical stability to resist oxidation. These oils must also have maximum lubricating value to lubricate pistons and cylinders efficiently.

Gargoyle D.T.E. oils for compressors have the combined characteristics for this job. Their strong film protects pistons, cylinders, and valves from wear with minimum oil feeds—and these oils fight the formation of deposits to keep the valves clean.

Be sure you have these oils in your compressor for maximum efficiency with the lowest possible maintenance and lubrication costs.

SOCONY-VACUUM OIL CO., INC., Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California.

GARGOYLE D.T.E. Lubricants

CALL IN SOCONY-VACUUM

HALL P-T-X SYSTEM

• the added factor in a f

Hall research has scored another first in its development of the P-T-X System to control deposition in boilers and turbines and to prevent corrosion from bonded oxygen

WHEN medical science perfects a remedy for a baffling disease, your physician is that much better fortified to keep you in good health.

The same holds true in the treatment of boiler ills. The new Hall P-T-X System for coping with certain boiler conditions which have heretofore resisted every attempt at a solution, makes Hall Service of preventive care more than ever a modern necessity.

To prospective users of Hall Boiler Service this gives an added promise of freedom from troubles arising from boiler water conditions. To the hundreds of leading plants which have consistently used this service, it is new evidence of the security it affords.

Preventive care, practiced by the Hall Laboratories trained field personnel, owes its successful performance to one factor which should mean more to you than any other—Hall Laboratories' unceasing research.

Every boiler ill reveals itself through symptoms to the trained observer. Preventive care is a system which enables you to detect these symptoms and apply a remedy before it is too late. This individualized operation explains the overwhelming success of Hall Serviced power plants. May we give you further particulars?

Siliceous scales can now be reduced or eliminated ➡ ***(see photo)*** **in high and low pressure boilers by the new Hall P-T-X system based on a potassium equilibrium instead of sodium. This is a *new* treatment *added* to Hall Service to meet certain conditions. It *does not* replace or make obsolete the present Hall System.**

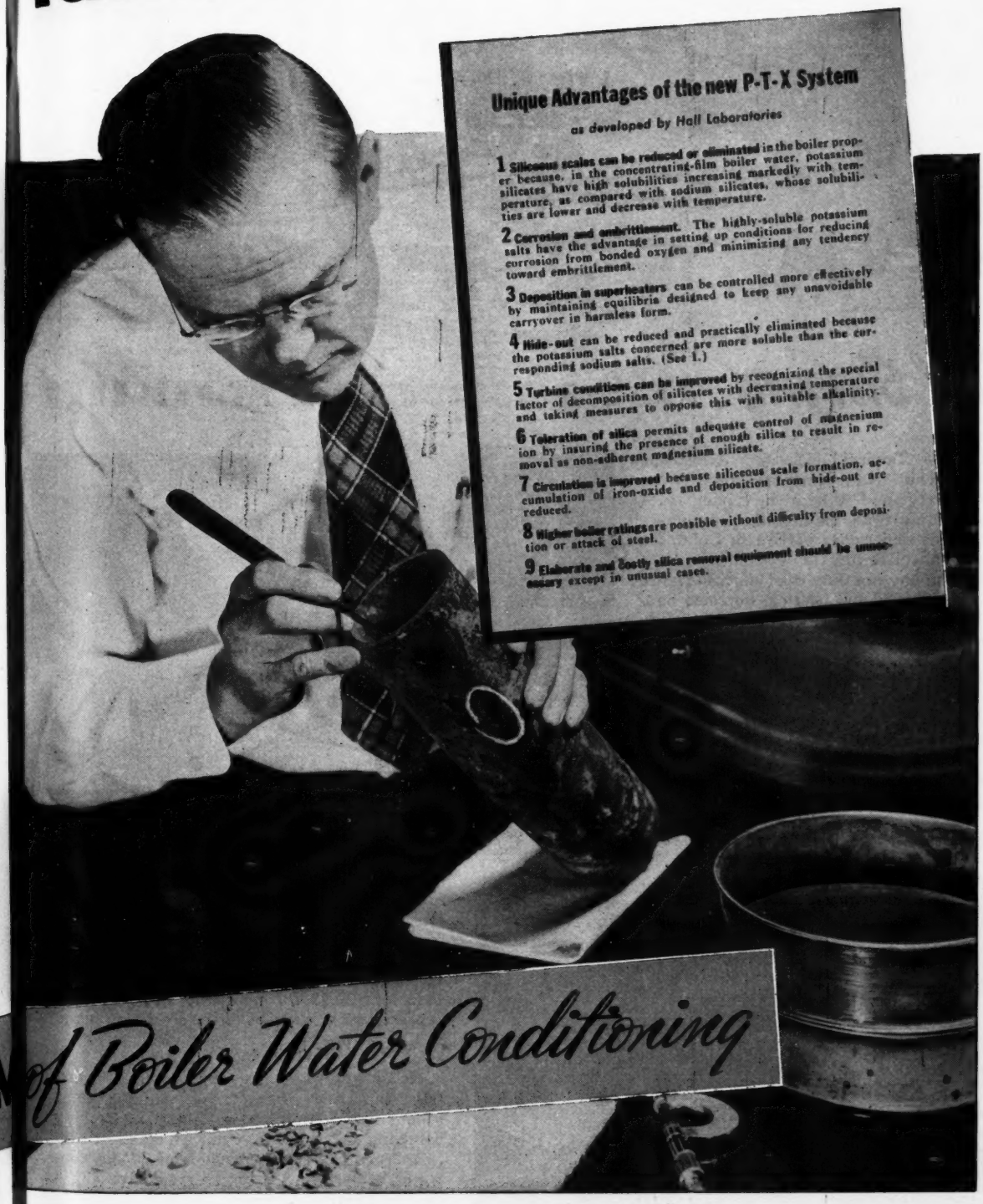
HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH 30, PA.

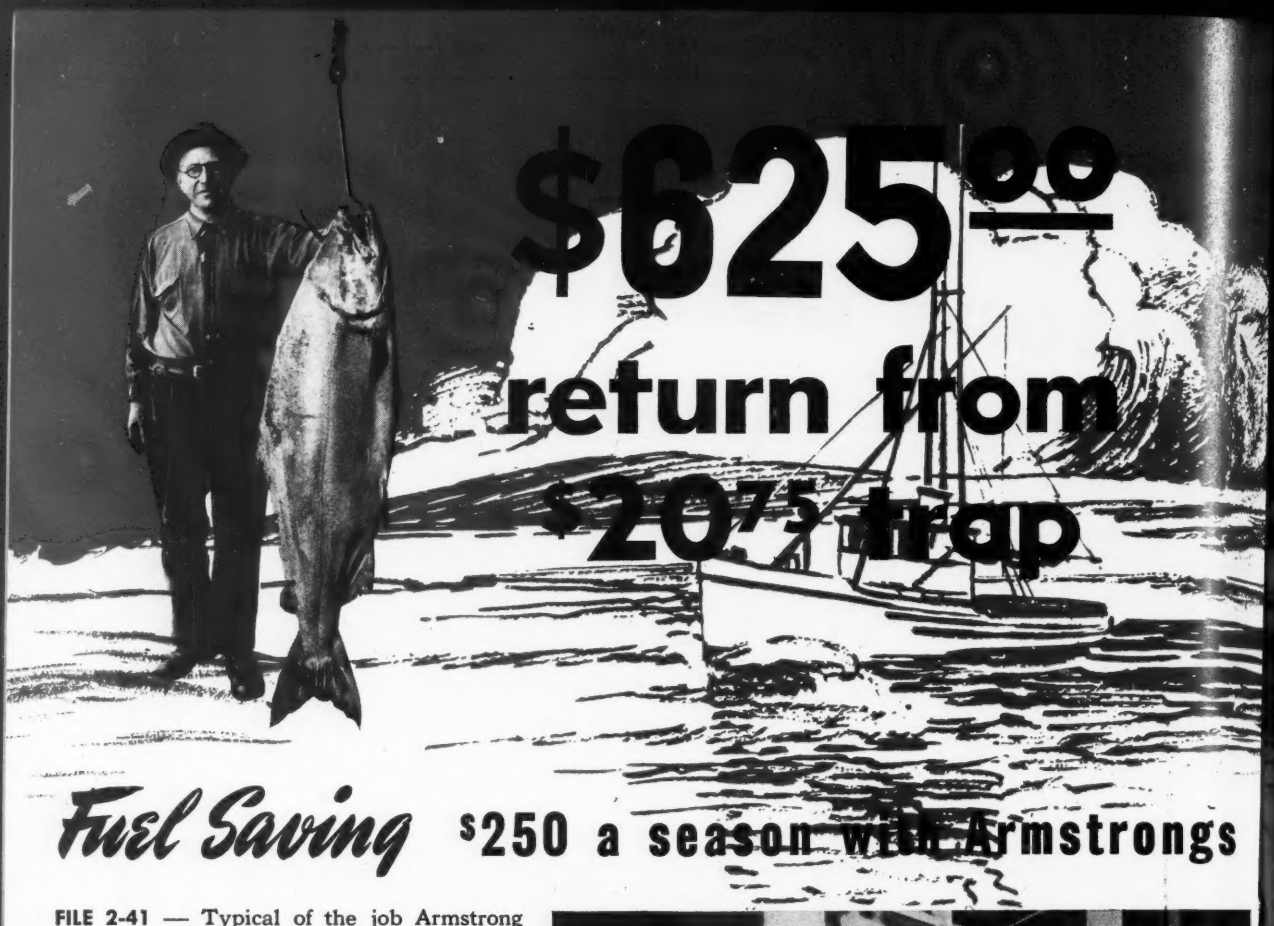
A SUBSIDIARY OF HAGAN CORPORATION

HAGAN HALL BUROMIN CALGON

HALL SYSTEM of

famous boiler service

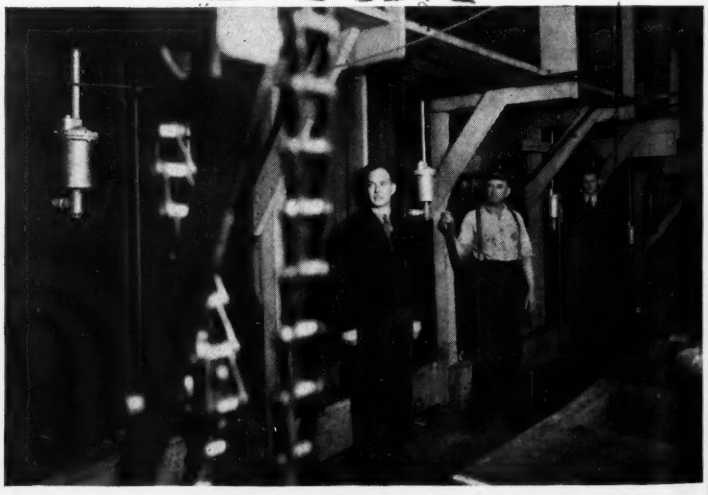

Unique Advantages of the new P-T-X System
as developed by Hall Laboratories
1 Siliceous scales can be reduced or eliminated in the boiler proper because, in the concentrating-film boiler water, potassium silicates have high solubilities increasing markedly with temperature, as compared with sodium silicates, whose solubilities are lower and decrease with temperature.
2 Corrosion and embrittlement. The highly-soluble potassium salts have the advantage in setting up conditions for reducing corrosion from bonded oxygen and minimizing any tendency toward embrittlement.
3 Deposition in superheaters can be controlled more effectively by maintaining equilibria designed to keep any unavoidable carryover in harmless form.
4 Hide-out can be reduced and practically eliminated because the potassium salts concerned are more soluble than the corresponding sodium salts. (See 1.)
5 Turbine conditions can be improved by recognizing the special factor of decomposition of silicates with decreasing temperature and taking measures to oppose this with suitable alkalinity.
6 Toleration of silica permits adequate control of magnesium ion by insuring the presence of enough silica to result in removal as non-adherent magnesium silicate.
7 Circulation is improved because siliceous scale formation, accumulation of iron-oxide and deposition from hide-out are reduced.
8 Higher boiler ratings are possible without difficulty from deposition or attack of steel.
9 Elaborate and costly silica removal equipment should be unnecessary except in unusual cases.
of Boiler Water Conditioning

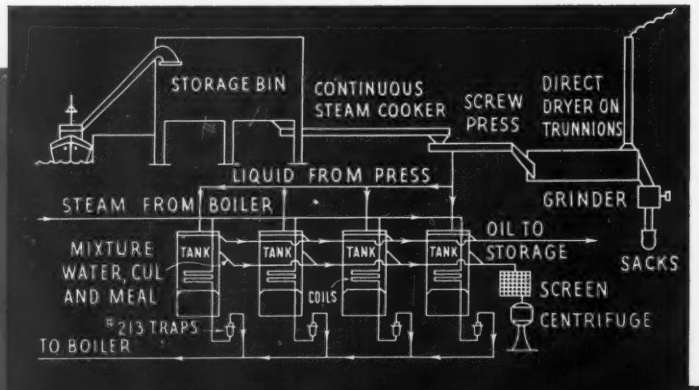


Fuel Saving $250 a season with Armstrongs

FILE 2-41 — Typical of the job Armstrong inverted-bucket steam traps are doing in the food industry and others in saving fuel, money, heating time, maintenance and manpower, is the experience of British Columbia Packers, Vancouver, B. C.

This company not only cans salmon, clams, oysters, pritchards and herring, but also handles the fish waste to convert it to valuable oils and meal for stock and poultry feed. Waste flows from storage by gravity to a continuous cooker where live steam is employed to do the cooking. After cooking the mass is fed into a hopper and then into a screw press, and the meal cake passed onto the dryer. Oil and water from the press pass into steam heated settling tanks. Prior to installation of No. 213 Armstrong Traps for draining these coils, the condensate was blown off to the atmosphere through cracked valves, wasting the heat of the condensate and providing only partial drainage from the coils.





With Armstrong trapping, the coils stay hotter with a resultant saving of twelve gallons of oil per hour. With four traps, the savings in fuel are about $250.00 per season, which over a conservative ten-year period figures to a return of $625.00 for an investment of $20.75 for each trap! The drawing represents a flow-sheet of the reduction plant.

Other Savings Reports

Other examples of savings in food industries with Armstrong Traps: canning plant speeds up cooking kettles 30% . . . Packing company saves $35 a year with smallest trap . . . Traps pay for themselves in 30 days, on water heaters . . . Traps on stills save $25 a day on fuel.

CUTS COOKING TIME 30%

Individual Armstrong traps with automatic air bypasses cut by 30% the time required to bring these 240 gallon jacketed kettles to a boil.

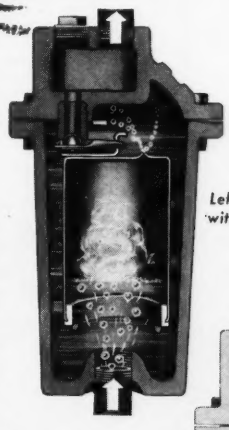
"Complete"

TRAPPING WITH ARMSTRONGS works wonders in all industries

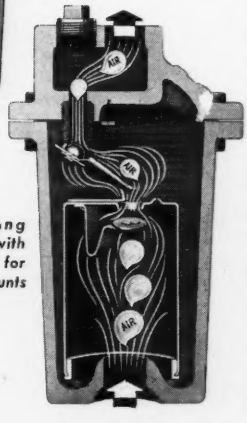
The amazing results secured by Armstrong traps in all industries is due to the Armstrong principle of "complete" trapping, both in the trap itself and in the method of installation.

Cracking a valve drains condensate but wastes steam. (A 1/16" orifice at 100 psi. wastes 13,200 lbs. of steam a month). Devices actuated by liquid level cannot draw off air. (½ of 1% by volume of air mixed with steam can cause a reduction in heat transfer efficiency of 50% according to one authority.) Heat actuated devices have to hold the condensate back until it cools below steam temperature to prevent loss of steam, therefore air has a hard time getting out. Continuous flow devices either obtain poor drainage at heavy loads, or use larger openings and lose steam on light loads.

Armstrong traps insure the highest possible fuel saving and heating speed by doing a *complete* job of drainage. They not only pass condensate as fast as it forms, without leakage of steam, but also eliminate air from the system and have the ability to handle all ordinary sludge and sediment. The patented free-floating valve and other engineering features insure freedom from wire-drawing in the valve orifice, permit holding tight against vacuum, and insure long life with negligible maintenance. Considering the hot condensate capacity, Armstrong traps are very small in size and low in cost. Considerably over a million are in use. Available in straight-through, angle and vertical piping styles. Standard Armstrong Traps for all sizes and pressures, and special traps for air, water, gasoline and other services, are described and illustrated in the Armstrong Trap Book, which also contains valuable data on operation, installation and service. We'll be glad to send you a copy.



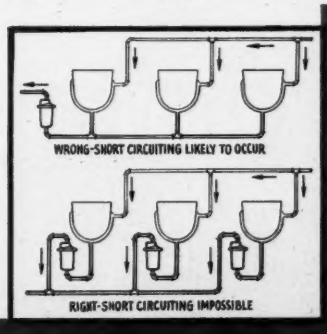
Left — Armstrong trap with bucket in "closed" position.



Right — Armstrong "blast" type trap, with auxiliary air vent, for handling large amounts of air.

ARMSTRONG MACHINE WORKS
810 Maple St. • Three Rivers, Mich.

"Complete" trapping also means the practice of applying a trap of proper size to each unit requiring drainage.



ARMSTRONG "INVERTED BUCKET" STEAM TRAP

Armstrong

STEAM TRAPS • AIR TRAPS • PURGERS • HUMIDIFIERS

Progress and Power in the BUILDING MATERIALS INDUSTRY

Few industries surpass the building materials industry in percentage of growth in the past several years. And certainly no industry will be more important to America's postwar development and progress.

The Public Utilities have been both directly and indirectly responsible for much of the progress by furnishing dependable, low cost power for every need.

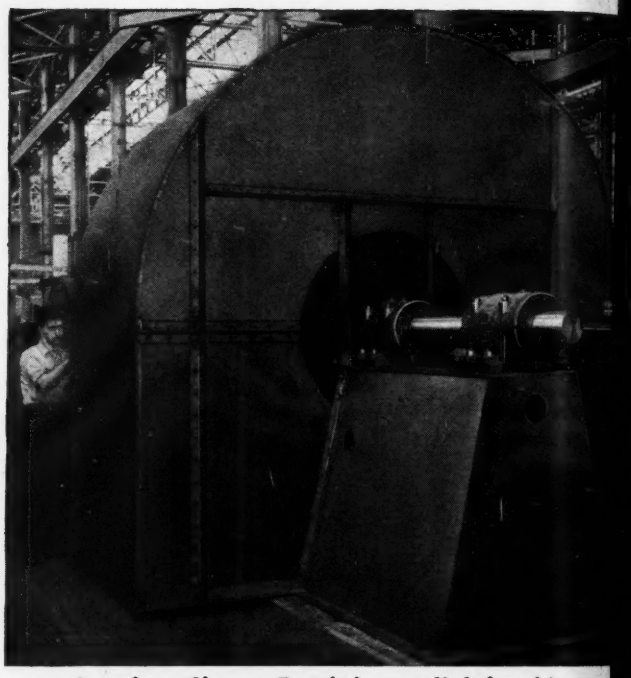
American Blower air handling equipment, mechanical draft fans, dust collectors, exhausters and fluid drives are used not only in the building materials industry but in many of the leading Public Utilities which serve this nation so ably.

MECH. DRAFT · AIR CONDITIONING · AMERICAN BLOWER · FLUID DRIVES · DUST COLLECTORS

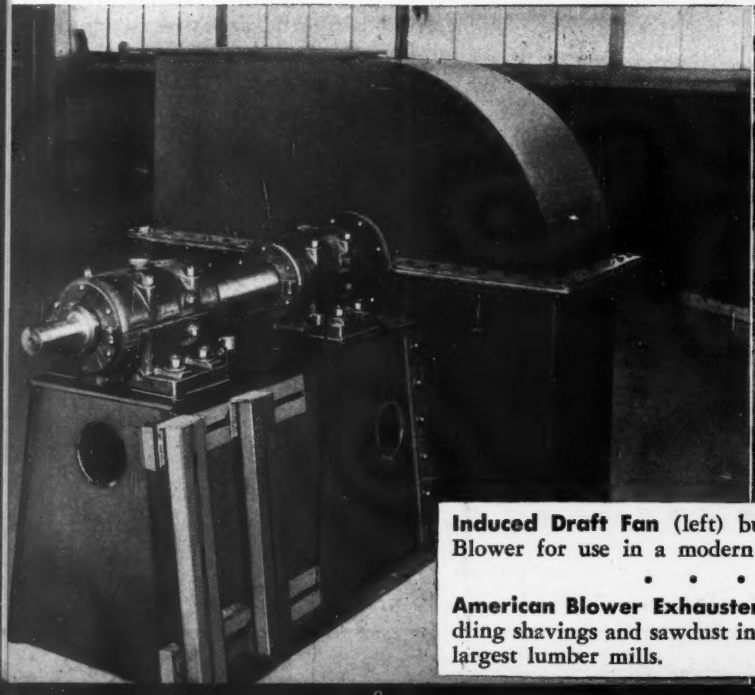
AMERICAN BLOWER

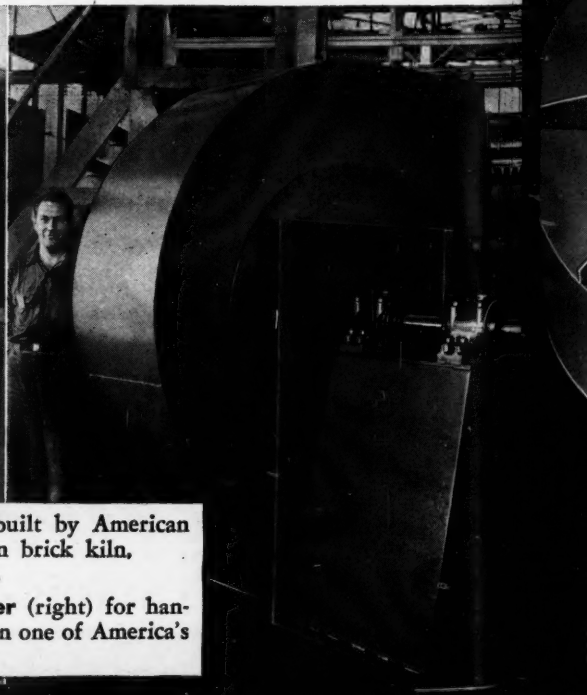
ARMY E NAVY
For Production "Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION



American Sirocco Fan being readied for shipment a nationally known plasterboard plant.





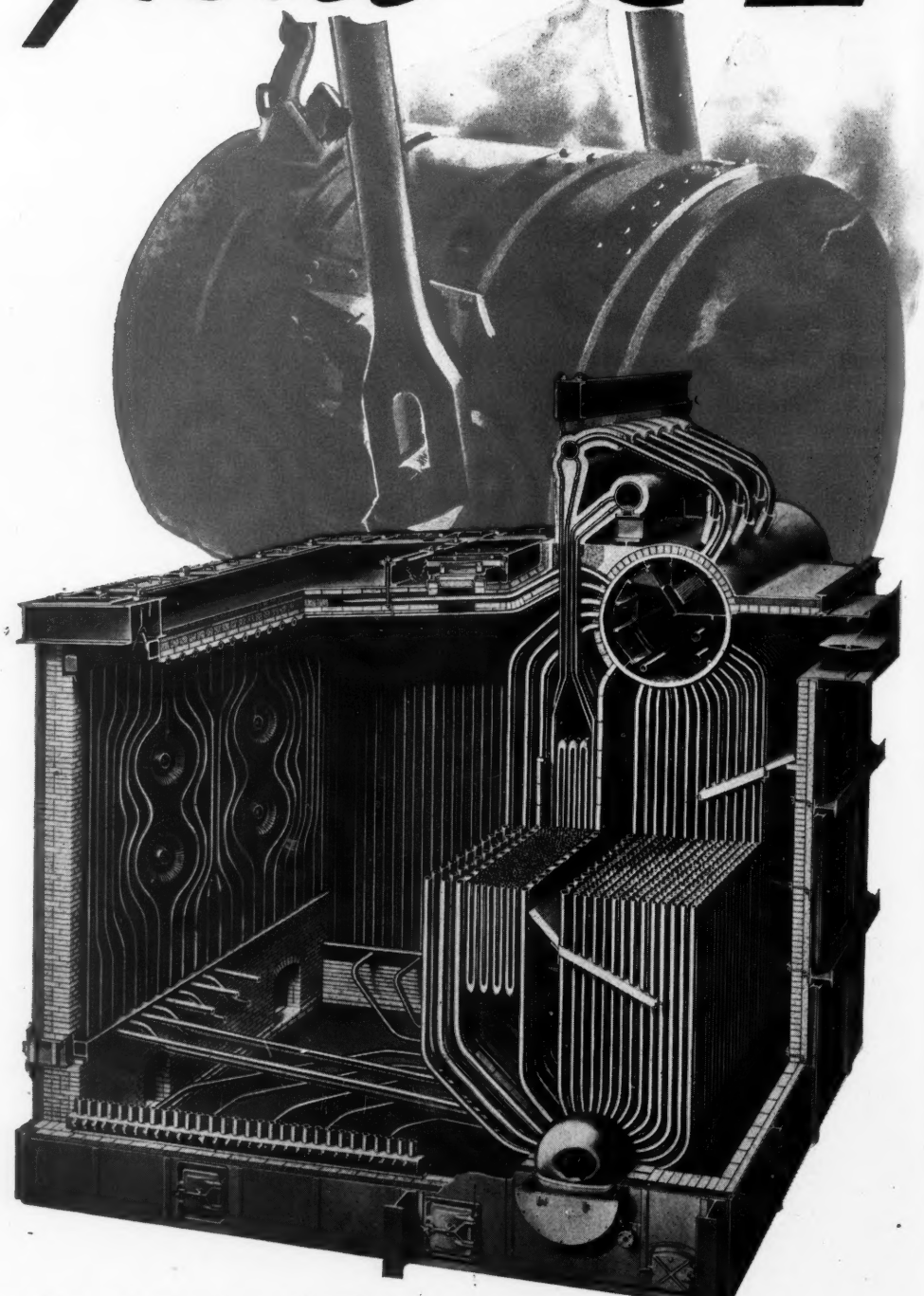
Induced Draft Fan (left) built by American Blower for use in a modern brick kiln.

• • •

American Blower Exhauster (right) for handling shavings and sawdust in one of America's largest lumber mills.

Centrifugal Collector under construction at an American Blower plant for collecting dust in a cement mill.

Three C-E



The three duplicate units responsible for the record reported on the opposite page are of the type shown above. Capacity — 72,000 lb of steam per hr. Design Press. — 375 psi. Steam Temp. 450 F.

Victory Units *

step up output to supply greatly increased steam demand of big steel mill

During the 12 months ending August 1, 1943, the tonnage shipped by a prominent steel mill was nearly double that contemplated when its three VU Units were installed. The following data show how these units responded.

CONTINUITY OF SERVICE

Combined use factor of all 3 units for the 12-month period, including regularly scheduled shutdown for check-up and maintenance – 92.5%. Combined availability – 96%. How well each unit carried its share of the increased load is evident from the following figures of hours in service for each unit during the year: 8,404; 8,408; 8,410.

CAPACITY RECORD

Designed for a maximum continuous capacity of 72,000 lb of steam per hr each, all 3 units have *averaged their maximum rate* over periods as long as a month and have considerably exceeded it for shorter periods.

Thus the extra values inherent in C-E design and construction are demonstrated once again by the fine performance of these VU Units. The same type of performance repeated in many different *war* plants has abundantly proved the excellence of the VU design for meeting every demand with consistent dependability. This quality of performance can be assured for your *peace-time* steam needs by specifying C-E. A-768

* Labelled The Victory Unit many months ago by a member of our Engineering Department who was impressed by the number of these units going into war plants.

COMBUSTION ENGINEERING

200 MADISON AVENUE C-E **NEW YORK 16, N.Y.**

Canadian Associates: COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver

DO YOU KNOW
MOBILGAS
MOBILOIL
USAF 12A1F

THESE SIX ADVANTAGES OF THE

NO-BLO TUYERE?

A TUYERE, though small, is a mighty important part of a stoker. Things can happen to it which defeat the purpose of fuel firing equipment—the generation of steam—continuously and at low cost.

The tuyere now available on Taylor Stokers climaxes many years of development—and answers the requirements of cold or preheated air. Its use, under severe conditions, has shown an increase in efficiency, in life, and in fuel burning rate at the same time accompanied by a lowered maintenance rate.

These are 6 specific reasons for this:

1. Improved design of air channels and air discharge —more finely divided streams of air.
2. Locking lug removed from nose—fastening remains intact even if nose is burned away.
3. High ratio of cooling area to heat absorbing area —means a cooler tuyere and longer life.
4. Less horizontal area per tuyere—smaller steps—less resistance to movement of fuel bed.
5. Fewer burnouts and longer life because of unique undercut fin construction. In the No-Blo design the fins terminate before reaching the edge of the tuyere toe, forming a peripheral air channel when slag blocks the air vents. Thus continuous proper air flow and air cooling is assured.
6. Greater coal burning capacity—less replacement expense.

Yes, the No-Blo Tuyere is just one of the features responsible for the efficient, reliable operation of the Taylor Stoker in generating steam at low cost. But it is an important one.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

IRON FIREMAN

SAVES 22½% COAL TONNAGE

View of stoker installation while construction was in progress at Egyptian Powder Co., Herrin, Ill.

Replaces Hand Firing at Egyptian Powder Company

AFTER years of hand-firing, the Egyptian Powder Co., Herrin, Ill., installed four Iron Fireman No. 5 CLC automatic coal stokers in 1941. According to Mr. R. C. Faris, Engineer for the company, the following results have been attained through the use of Iron Fireman:

1 **COAL SAVING:** 22½% reduction in coal tonnage.

2 **MANPOWER SAVING:** Expanded operations have required no additional manpower in the power plant.

3 **INCREASED EFFICIENCY:** Three boilers now carry the load comfortably, whereas four were required with hand-firing. Iron Fireman has provided a "spare" boiler.

4 **UNIFORM STEAM PRESSURE:** Uniform steam pressure is now readily maintained for engine operation.

In the interest of coal conservation, and your own plant efficiency—as well as labor savings and money savings—find out what Iron Fireman can do for you.

Iron Fireman Stokers are Available

Because their performance contributes so greatly to the nation's war economy, Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Company, 3524 West 106th Street, Cleveland 11, Ohio.

IRON FIREMAN

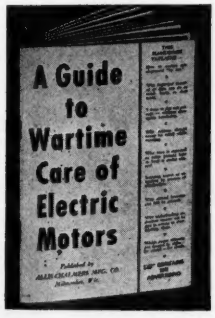
AUTOMATIC COAL STOKERS

This is a bunker model; feeds from main bin direct to fire. Outstanding performance of Iron Fireman stokers is the result of the application of sound principles of combustion and engineering. Coal is fired under forced draft, with automatic regulation of air and coal to produce efficient combustion. Sizes now available for firing commercial and power boilers up to 1000 h.p. and larger. Pneumatic Spreader models burn low grade high ash and clinkering coals as readily as higher grade coals. Bunker-feed type eliminates coal handling.

FIRST AID FOR MOTORS

MOTORS RUN A FEVER? No wonder if they do more often today. They're working *3 and 4 times* as many hours as in peace!

Wartime conditions demand you diagnose motor ailments *quickly* ... remedy the trouble at once. At right are but few of the many diagnoses found in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors". In maintenance as in war, *attack is the best defense.* This book singles out the 9 main enemies of electric motors . . . tells you how to get them *before* they get your motors!



Over 100,000 copies already in use.

Write today for your *free* copy. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

SYMPTOMS YOU CAN *SEE*

Symptom	Possible Causes	Cure
1. Excessive sparking or flashing at brushes. Blackened commutator.	Rough commutator.	Sand or turn down, depending upon depth of surface roughness.
	Low bar on commutator.	Grind or turn down balance of commutator.
	High bar on commutator.	If extreme, lower with mallet, tightening clamping ring. Grind true.
	Brushes too short.	Replace with harder grade—if worn too soon . . . and not by rough commutator.
	Shorted armature winding.	Test for short—after removing metallic contact between commutator bars. Repair.
2. Intermittent sparking at brushes.	Open armature winding.	Locate and replace bad coil—or repair defective joint.
3. Motor won't start.	Usually line trouble.	Correct. Check source of power supply.
	Load too heavy. See if motor runs without load.	Reduce load—or replace motor with unit of greater capacity.

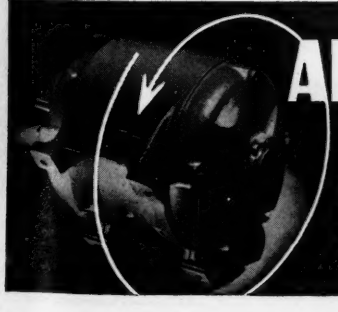
SYMPTOMS YOU CAN *HEAR*

4. Excessive hum.	Uneven air gap. Measure with feelers.	Replace bearings—before introduction of scraping noise indicates rotor is rubbing.
	Unbalanced rotor. Check on parallel bars.	Balance with solder on band—or weight attached by cap screw and lock washer.
5. Regular clicking.	Matter in air gap.	Take out rotor; remove matter.
6. Rapid knocking	Misalignment.	Realign set until knocking disappears.
7. Brush "chatter."	Extreme vibration.	See item 10, below.

SYMPTOMS YOU CAN *FEEL*

8. Vibration.	Misalignment.	Realign set.
	Vibration in driven machine.	Eliminate source in machine, if possible. Or a flexible belt drive may be in order.
9. Motor overheating. (Check with thermometer—don't depend on hand).	Overload. Measure load; compare with nameplate rating.	Check for excessive friction in motor, drive or machine. Reduce load, or replace motor with greater capacity unit.
	Dirt in motor. Check flow of air.	Blow out motor. Use solvent on wound section if necessary.
	Rotor rubs stator.	Replace bearings.

A 1638

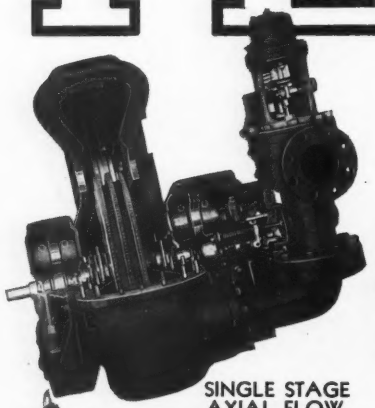


ALLIS-CHALMERS MOTORS

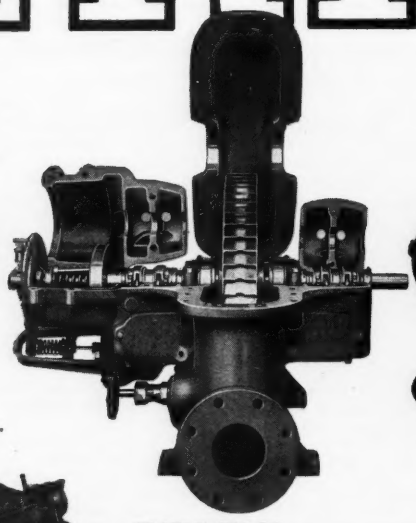
When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

AC WE WORK FOR VICTORY WE PLAN FOR PEACE

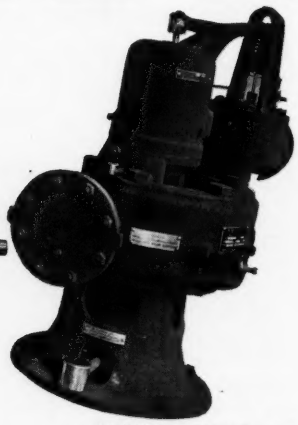
TERRY



SINGLE STAGE
AXIAL FLOW,
THREE ROW WHEEL.

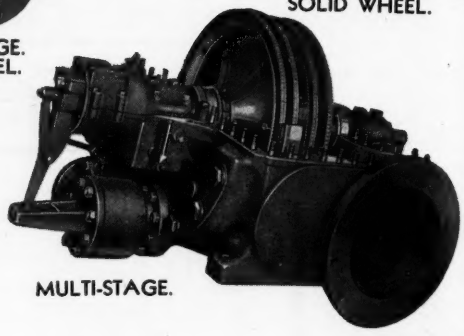


SINGLE STAGE.
SOLID WHEEL.



VERTICAL SINGLE STAGE
SOLID WHEEL.

MULTI-STAGE.
OIL RELAY GOVERNOR.



MULTI-STAGE.

Multi-Stage and Single-Stage Steam Turbines For All Mechanical Drive Applications

Terry Turbines are built in all sizes up to 2000 HP and for all commercial steam pressures and exhaust pressures. They are available for condensing, non-condensing, low pressure, mixed pressure and bleeder operation.

The types include

—Terry Solid Wheel Turbines.
—Single Stage Axial Flow Turbines, using either two or three rows of blading.
—Multi-Stage Impulse Turbines.

Our engineers will be glad to submit data and estimates on the proper type to meet your requirements.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

MORE THAN METERS AND CONTROLLERS

A Bailey Boiler Control System is more than just a group of meters and controllers recording and controlling certain factors in the boiler plant. It is a means of improving plant operation from the standpoints of:—

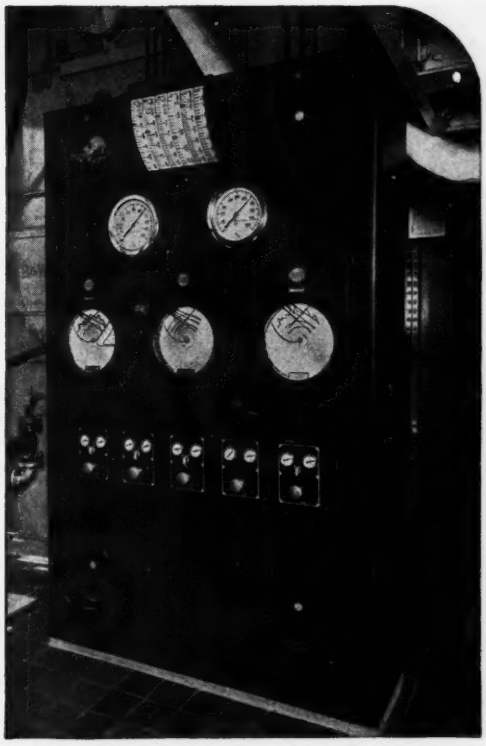
1. Continuity of service **3. Steaming capacity** **5. Safety**
2. Fuel conservation **4. Conservation of manpower**

Bailey Control Systems are effective because each system is carefully engineered to the requirements of the unit which it serves. The experience gained from thousands of successful combustion control installations serves as a basis for this engineering service which starts with the selection of equipment and continues through the design, construction, calibration, installation and final adjustment on the job.

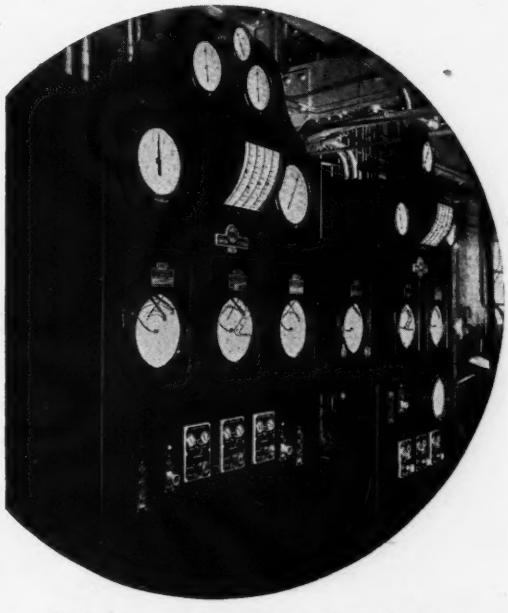
Engineering work is done in the user's plant by Bailey Field Engineers who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey engineer in your community has a wide background of combustion engineering know-how at his command. It includes the records of tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel-burning equipment. He has more to offer than meters and controllers. He is primarily interested in helping you to secure optimum operating conditions in your plant.

G-19



Bailey Boiler Control Panel for 100,000 lb. per hour capacity Integral-Furnace Boiler



Bailey Boiler Control System in an Eastern Paper Mill

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

For Reconversion of War Industries

A tough job is ahead. The tremendous power for war time industries must be turned into power for peace. Unless the job is done and done well the entire economic framework of American industry may collapse.

Power planning should start now. But, until such time as actual reconversion is necessary, existing plants must be kept in top shape. The peak load is still to come. Careful maintenance and fuel saving are one, two, for the duration.

Postwar industry will require a greater variation of service and power to meet a diversified civilian production and decentralization. Competent engineering is essential. Theory and practice must combine. In this respect, J. F. Pritchard and Company Power Engineers are ready to help you with your power planning. From the fundamental prime mover through the ultimate power use, Pritchard Power Engineers can design, engineer and construct your power plant. J. F. PRITCHARD and COMPANY, *Power Division*, Fidelity Building, Kansas City, Missouri.

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ENGINEERS AND CONSTRUCTORS

FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES

Manufacturers of Mechanical and Atmospheric Cooling Towers

THE *Preferred* FLANGED JOINT FOR WELDED PIPING SYSTEMS

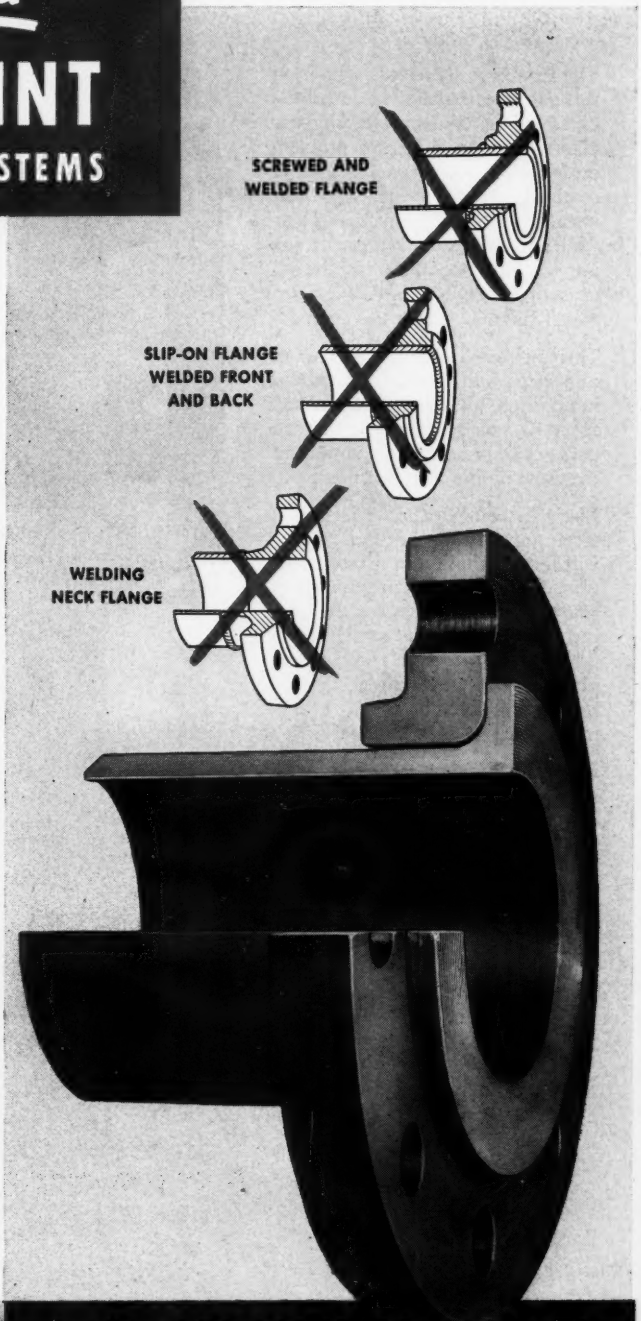
MIDWEST

LAP-JOINT STUB ENDS

For making connections to boilers, pumps, valves and other flanged outlets (and where piping must be frequently cleaned or inspected for corrosion), Midwest Lap-Joint Stub Ends have a tremendous advantage over flanges that are welded to the pipe (see drawings at right above). The swivel flange on the Stub End makes it unnecessary to accurately line up the bolt holes before welding; "setting up" is simple and quick because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. The result is a real saving in time and cost of welding.

Another important economy is in erection. Field organizations report a saving of 25% in erection time for making up a joint using Midwest Lap-Joint Stub Ends in comparison with flanges rigidly fixed to the pipe; this saving is even greater when the flanges are on bends.

See Bulletin WF-41 for complete data regarding Midwest Lap-Joint Stub Ends . . . and the many other Midwest Welding Fittings that simplify and save on welded piping.



MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Building.

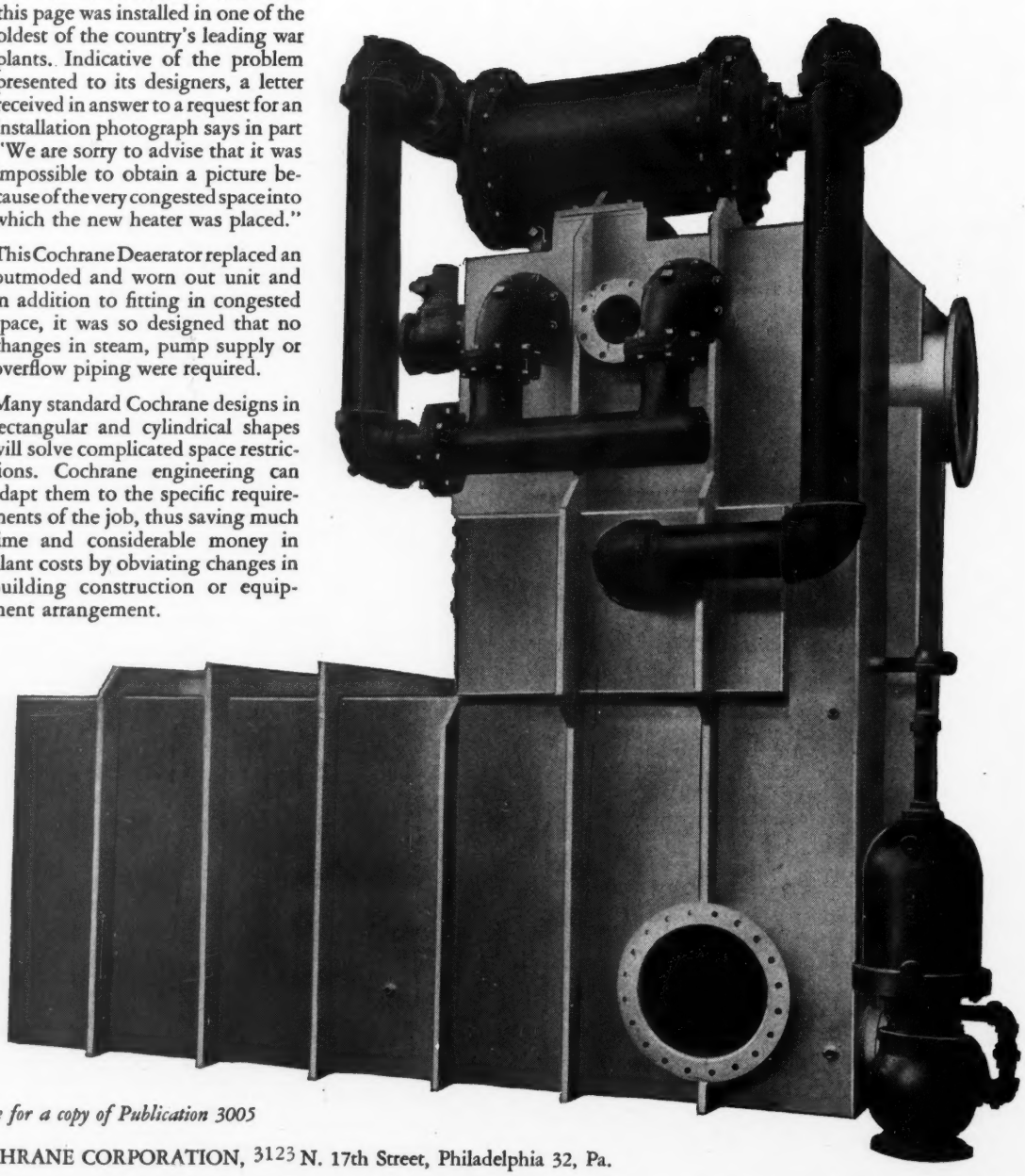
MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS

"...very congested space..."

The Cochrane Deaerator shown on this page was installed in one of the oldest of the country's leading war plants. Indicative of the problem presented to its designers, a letter received in answer to a request for an installation photograph says in part "We are sorry to advise that it was impossible to obtain a picture because of the very congested space into which the new heater was placed."

This Cochrane Deaerator replaced an outmoded and worn out unit and in addition to fitting in congested space, it was so designed that no changes in steam, pump supply or overflow piping were required.

Many standard Cochrane designs in rectangular and cylindrical shapes will solve complicated space restrictions. Cochrane engineering can adapt them to the specific requirements of the job, thus saving much time and considerable money in plant costs by obviating changes in building construction or equipment arrangement.



Write for a copy of Publication 3005

COCHRANE CORPORATION, 3123 N. 17th Street, Philadelphia 32, Pa.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

DON'T HANG YOUR PRODUCTION ON A *Shoestring* PLANT POWER SYSTEM

● **POWER DISTRIBUTION SYSTEMS, like shoestrings, are generally kept in service till something *snaps*. Minor troubles are laid to other causes, and major breakdowns come too late for preventive remedy.**

Today, many otherwise well-equipped plants are "just getting by on a shoestring" when it comes to electric power supply, with make-shift circuits, hand-me-down equipment, and long, overloaded feeders.

If your power system was adapted and extended under pressure to carry loads it was never designed to meet, the chances are that it's partly or wholly inadequate—it's the overlooked cause of outages, poor lighting, sluggish drives, high power losses, extra maintenance expense, and danger to personnel. Nurse it through for the time being if you must, but plan your next move to get away from these risks and losses.

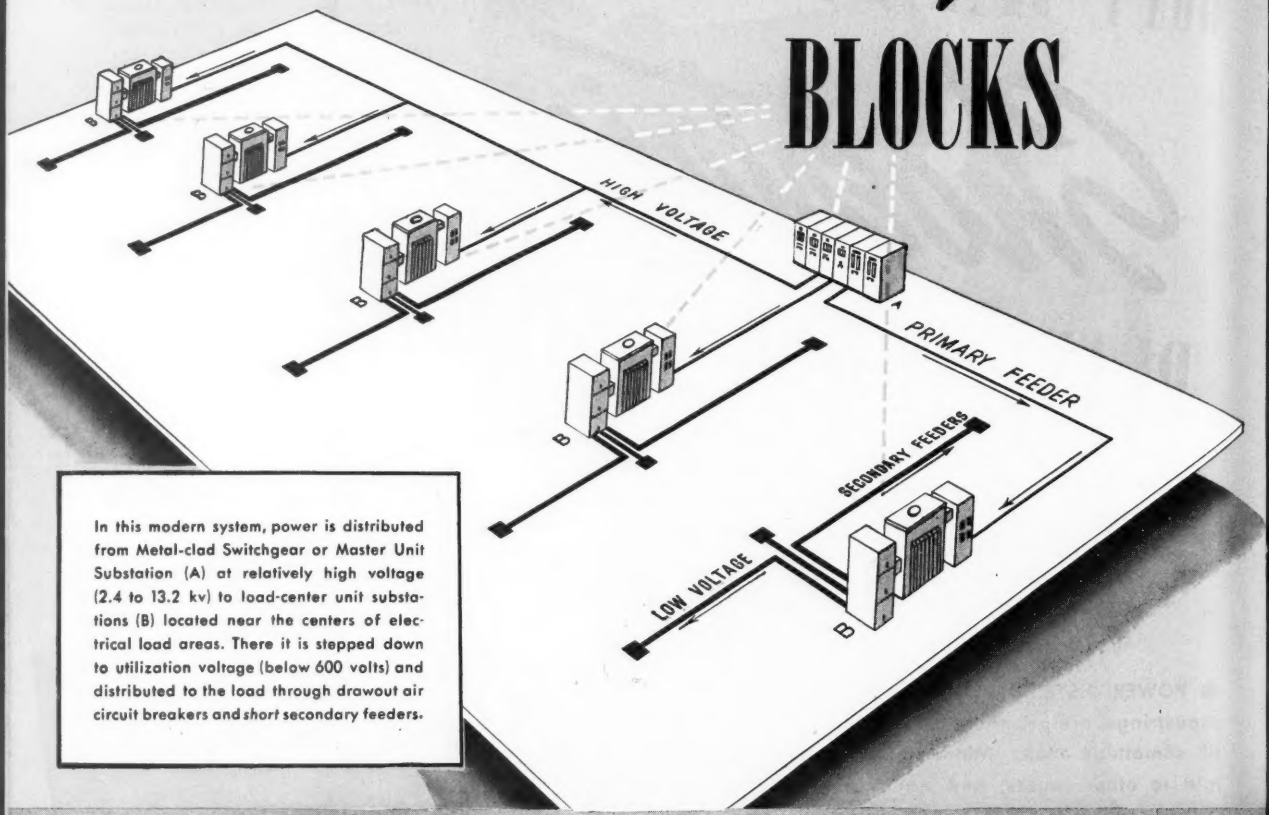
GENERAL ELECTRIC

302-27-5900

HERE'S *News* . . .

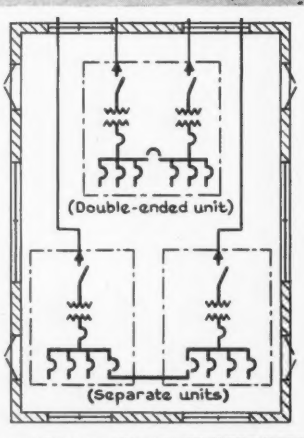
of modern power distribution—G-E 3-load-center system, which you can install as a complete system, or block by block until the complete system is assured.

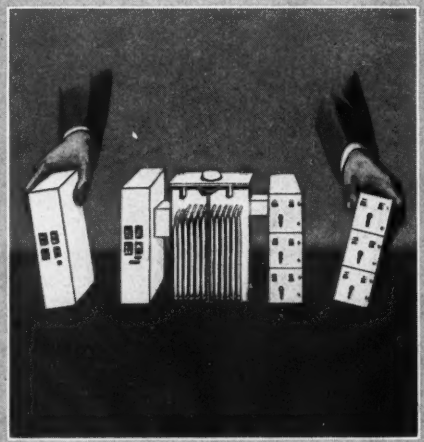
Electric POWER-SUPPLY SYSTEM *based on ready-built* BLOCKS

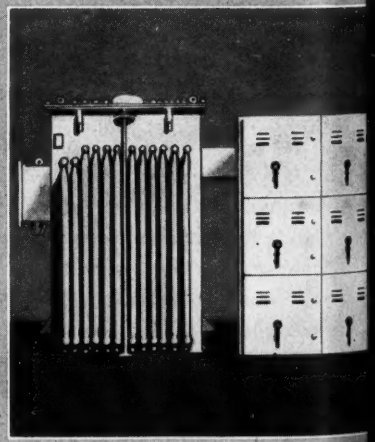


In this modern system, power is distributed from Metal-clad Switchgear or Master Unit Substation (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through drawout air circuit breakers and *short* secondary feeders.

THE CIRCUIT ARRANGEMENT YOU NEED — BUILT UP FROM CO-ORDINATED UNITS — OF STANDARD DESIGNS — REP







No system is more *flexible* than load-center distribution. Units can be combined in any one of a number of basic circuit arrangements. (Diagram shows secondary-selective hook-up.)

Like a set of blocks, the elements that go to make up a complete electric power system can be combined in many ways, without engineering or construction delays. All parts are designed to work together.

The components of a G-E unit substation are of standard design. Installation and maintenance are simplified; no worries about oddities or misfits. You get exactly the right assembly for the load conditions.

SAFEGUARDS

Your Plant from Crippling Outages

THIS MODERN SYSTEM FOR DISTRIBUTING ELECTRIC POWER protects your plant from power shutdowns in two ways: Low-voltage power is distributed from unit substations within definite load areas. Circuit protection here ISOLATES trouble, leaving all other areas unaffected.

In addition, each individual substation is unusually strong in SELF-PROTECTION features. By co-ordinated "system" arrangements, two or more sources of supply to any local circuit can easily be provided.

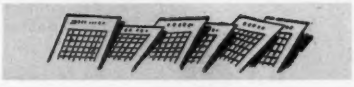
DELIVERS

Full Voltage to Every Lamp and Machine

LONG, CIRCUITOUS LOW-VOLTAGE FEEDERS are eliminated by the load-center system. This ends the basic cause of most low-voltage troubles, and limits costly IR-drop losses. Dim lighting and sluggish power are avoided. Each substation is matched to local load conditions within your plant, and delivers full-voltage power over short, direct feeders to motor controls, lighting panels, and the like. Wiring problems are simplified. Naturally, this method also means great savings in cable copper.

SAVES TIME

In Plant Planning and Conversion

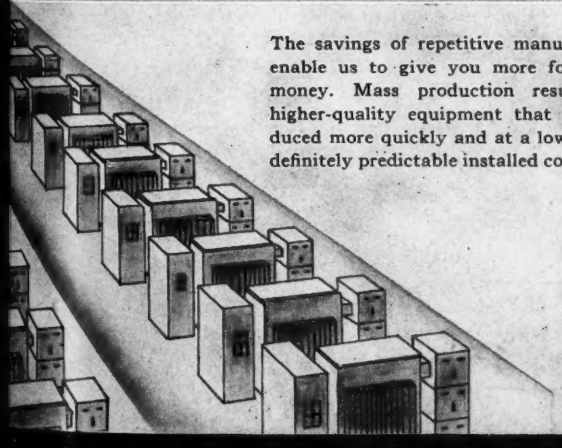


LOAD-CENTER POWER DISTRIBUTION SYSTEMS enable your engineers to make maximum use of available standard apparatus such as unit substations and metal-clad switchgear. They can be laid out by means of a simple "one-line" diagram, fitting ready-built equipment combinations to your specific needs. This method permits placing orders months earlier, and thereby gets plants into production sooner.

If plant conversion alters power loads, substations can be quickly relocated.

Ask for Bulletin GEA-3758A

REPETITIVELY MANUFACTURED



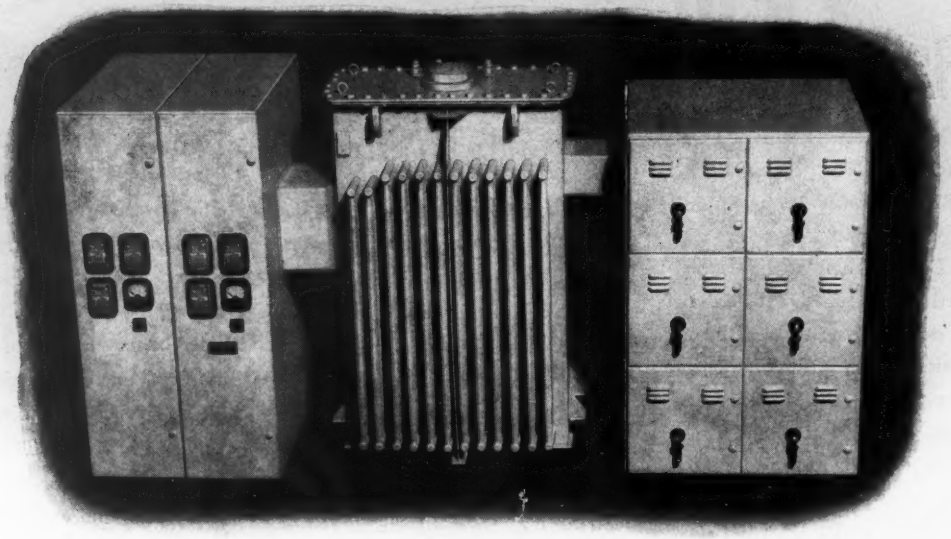
The savings of repetitive manufacture enable us to give you more for your money. Mass production results in higher-quality equipment that is produced more quickly and at a lower and definitely predictable installed cost.

LOAD-CENTER POWER DISTRIBUTION SYSTEMS

GENERAL ELECTRIC

THE G-E UNIT SUBSTATION

Is the Basic Building Block of Load-center Systems



★ **Each block is a completely co-ordinated unit, as easy to specify as a standard machine tool.**

★ **Safely "at home" anywhere in the plant because of the Pyranol transformer and metal-enclosed switchgear.**

★ **Offered in flexible combinations of incoming-line and secondary-circuit arrangements, from 200 to 2000 kva.**

Metal-clad primary protection. Each high-voltage circuit is isolated in its separate, grounded, steel compartment.

Vertical-lift breakers are easily removable for inspection. For safety's sake, you can't elevate or lower breakers unless they are open.

Drawout air circuit breakers for secondary circuits are individually metal-enclosed. Breakers are interchangeable, avoiding delays during routine maintenance. Interrupting capacities are correct for the transformer ratings.

The PYRANOL* transformer section makes vaults unnecessary for indoor installation. No Pyranol transformer has ever burned or contributed to a fire. Pressure-tight tanks protect vital parts from dust, dirt, dampness. Little or no maintenance is required.

The heat-storage capacity of the core-and-coils and of the cooling liquid makes the Pyranol transformer ideal for emergency overloads.

As an integral part of a G-E unit substation, each transformer is electrically matched with its accompanying primary and secondary switchgear.

More information in Bulletin GEA-3592. *General Electric Company, Schenectady, N. Y.*

Ask your local G-E representative about—

BUY WAR BONDS

LOAD CENTER Power Distribution Systems

*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

As a major producer of heat exchanger and vacuum equipment, Lummus designs and builds a complete line of

HEAT EXCHANGERS, CONDENSERS and VACUUM EQUIPMENT

FOR EVERY POWER PLANT NEED

★ Surface Condensers
★ Steam Jet Air Pumps
★ Bleeder Heaters
★ Boiler Blowdown Heat Exchangers
★ Evaporators
★ Fuel Oil Heaters
★ Lubricating Oil Coolers
★ Steam Jet Refrigeration

The services of Lummus engineering personnel are available to public utilities and industrial power plants for the study of specific problems and the design of heat exchanger and vacuum equipment to meet individual conditions.

THE LUMMUS COMPANY

LUMMUS

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

FOR over 25 years, engineers have depended on Johns-Manville Service Sheet for their gaskets. As a result of its performance under widely varying temperature and pressure conditions against steam, oil and other fluids, gases and chemicals, J-M Service Sheet is recognized as the No. 1 sheet packing today.

Over the years, J-M Service Sheet has been constantly improved to meet the increasingly severe demands of industry. Its dependability and high degree of uniformity are the result of quality ingredients and special manufacturing techniques developed during nearly three-quarters of a century of experience in the production of packings.

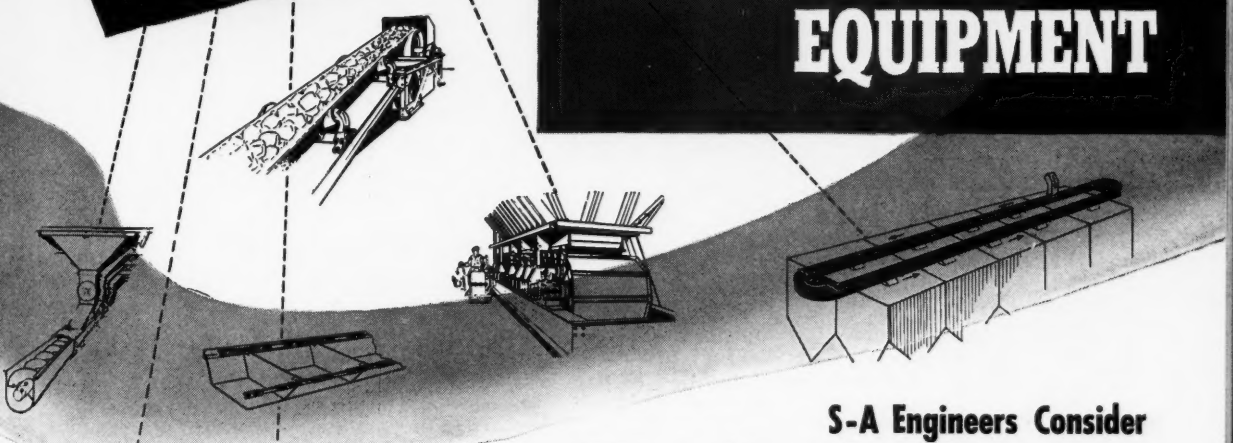
For details on Johns-Manville Service Sheet and on the complete line of J-M Packings and Gaskets, write Johns-Manville, 22 East 40th Street, New York 16, N. Y.

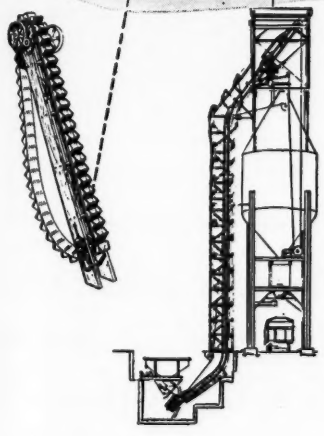
JM

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

THE *Right* METHOD THE *Right* EQUIPMENT





S-A Engineers Consider All Types of Material Handling Equipment

● Material handling is so critical a part of virtually every industrial operation that no plant man will want to make a decision on equipment until he is convinced that the system recommended is the exact system needed for maximum efficiency and economy.

Consult S-A Engineers on your current or post-war handling problems, as they are in a position to give you the benefit of 42 years of experience in the solution of your Material Handling problems.

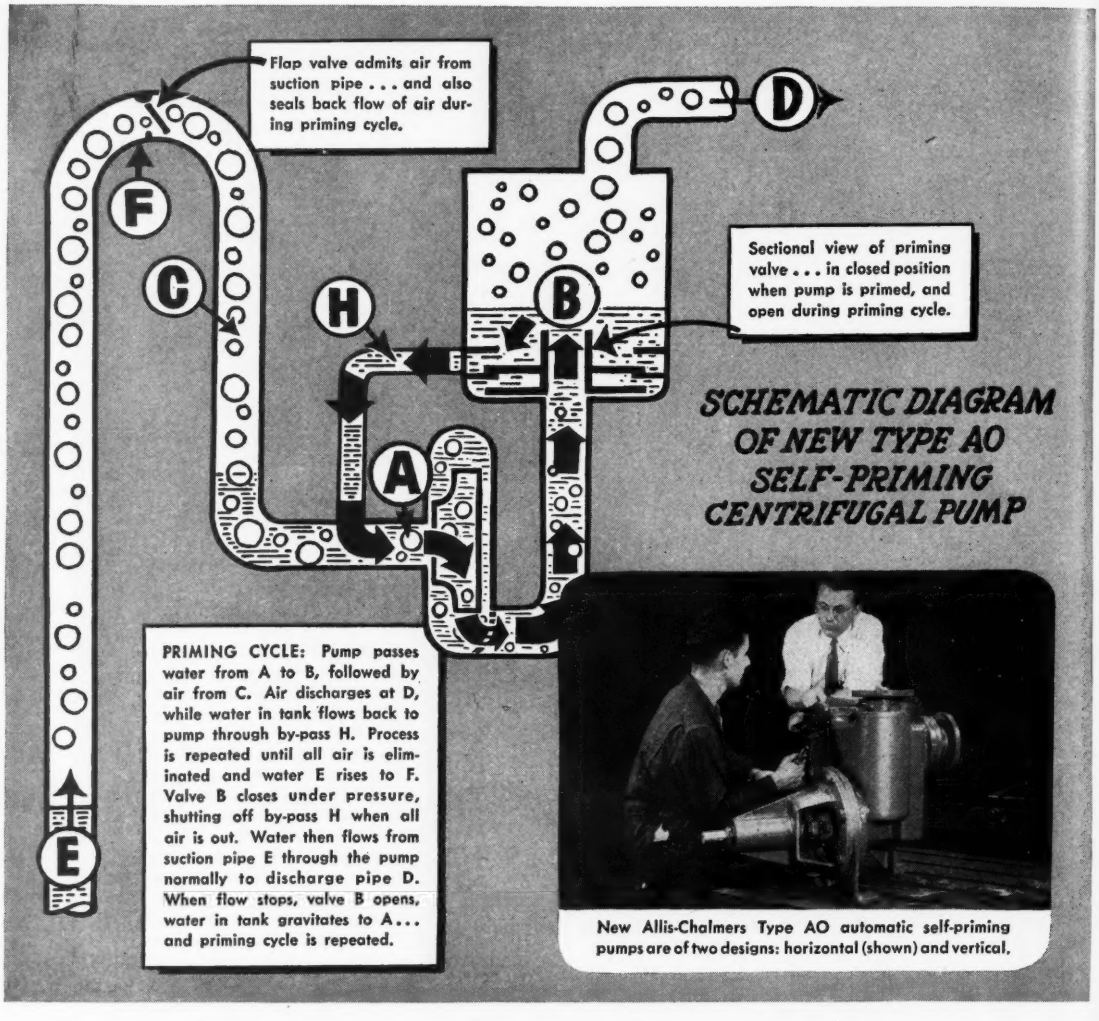
Stephens-Adamson designs and manufactures all types of conveying units required in any recommended systems

515 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

STEPHEN S-A DAMSON MFG. CO.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

PRODUCT OF THE MONTH

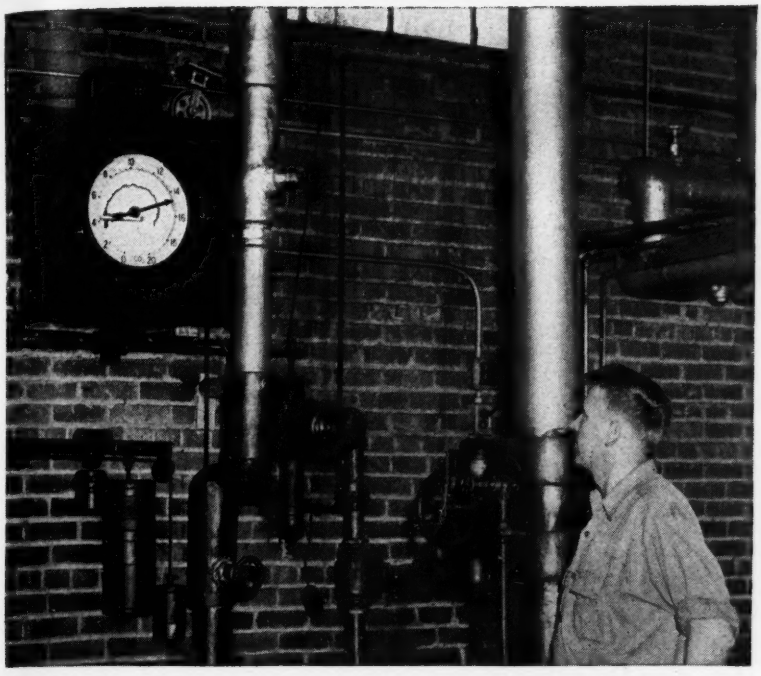

Flap valve admits air from suction pipe . . . and also seals back flow of air during priming cycle.
Sectional view of priming valve . . . in closed position when pump is primed, and open during priming cycle.
SCHEMATIC DIAGRAM OF NEW TYPE AO SELF-PRIMING CENTRIFUGAL PUMP
PRIMING CYCLE: Pump passes water from A to B, followed by air from C. Air discharges at D, while water in tank flows back to pump through by-pass H. Process is repeated until all air is eliminated and water E rises to F. Valve B closes under pressure, shutting off by-pass H when all air is out. Water then flows from suction pipe E through the pump normally to discharge pipe D. When flow stops, valve B opens, water in tank gravitates to A . . . and priming cycle is repeated.
A
B
C
D
E
F
H

New Allis-Chalmers Type AO automatic self-priming pumps are of two designs: horizontal (shown) and vertical.

MILWAUKEE, WIS.—Allis-Chalmers announces a new automatic self-priming centrifugal pump, Type AO, which insures high efficiency through use of a new-type spring valve. The AO is especially adaptable to applications where speed of installation is important. Available for high priority jobs. A 1668

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ALLIS-CHALMERS · MILWAUKEE · WISCONSIN



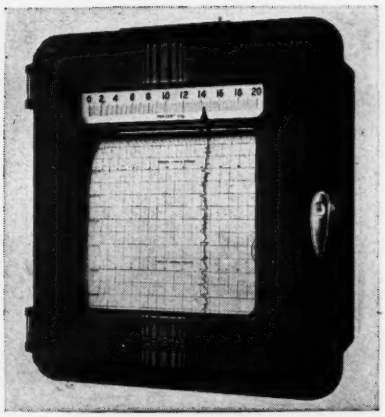
Located high above the floor so that it can be read far down the firing aisle, this Micromax Round-Chart CO_2 Recorder helps a New York State plant to save coal by improving combustion beneath its stoker-fired boilers.

TRYING TO SAVE FUEL?

Maybe a Micromax CO_2 Recorder Can Help

Freed by the Micromax CO_2 Recorder from the job of analyzing flue-gas, at frequent intervals, many a plant engineer is saving fuel simply because he knows more about CO_2—and knows it more quickly — than ever before. For when the Micromax shows the need of a change in air supply to the boiler, the engineer makes the correction with speed; and quickly sees the result on the Recorder's chart. He can tell, from minute to minute if he wishes, just how combustion stands in relation to optimum efficiency. And he has the CO_2 records to help plan future operating savings.

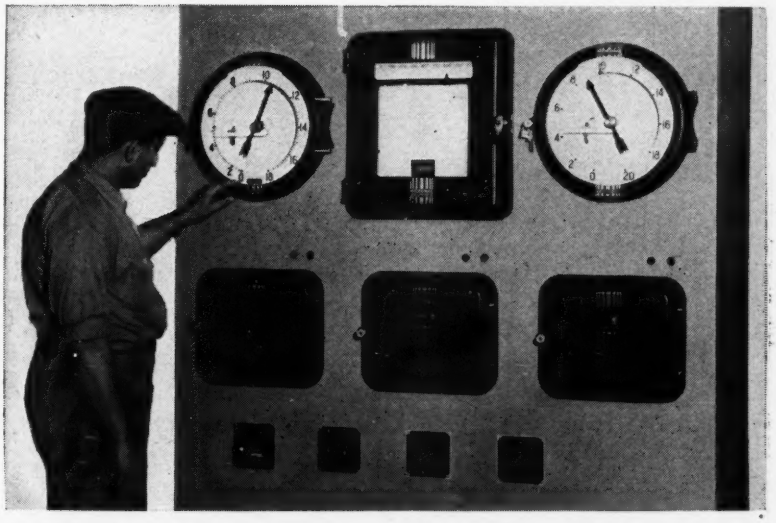
One of the outstanding successes of modern instrumentation has been scored by this Recorder. Coming into the power field when CO_2 recorders were widely regarded as not practical, this instrument was on a "make good if you can" basis in every early installation. Two or three types of CO_2 meters were already available; the arrival of still another didn't rouse much comment—at first.



The Strip-Chart form of Micromax CO_2 Recorder is preferred by some users.

But the comment came quickly enough after a few installations had been made, because the new device overcame the standard objections to automatic CO_2 meters—it was sensitive, it was not easily damaged in use, and it required practically no servicing. Users checked it, found it accurate; could see for themselves its other qualities; came to depend on it.

Today, wherever any thermal-conductivity-method recorder can be used, these advantages of sensitivity, sturdiness and low maintenance can be enjoyed. If you have a CO_2-analysis problem, one of our engineers will gladly tell you more about Micromax. If you prefer a quick, clear, printed description, ask for Catalog N-91-163.



Micromax Recorders for Flow, Temperature and CO_2, being mounted, together with Metermax Combustion Control, on a boiler-control board before shipment from our plant. These panels arrive ready for connection to boiler, etc.; greatly simplify the installation.

A Slogan For Every American

Jrl Ad N-91-163(12)

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

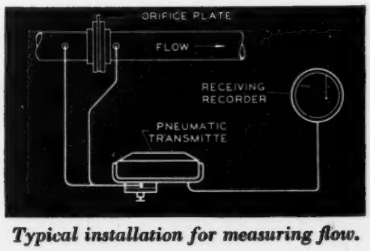
Easy spreading
Now SEAL both OIL and WATER
NEW JOHN CRANE
PLASTIC LEAD SEAL
Insoluble
FOR Heavy duty
PIPE-LINE, REFINERY, MARINE, POWER, CHEMICAL, AVIATION, INDUSTRIAL USES
Temperatures to 600° F. . . . Pressures to 4000 pounds per sq. in.
SERVICES: Oil, gasoline, kerosene, benzol, propane, butane, bottled gases, steam, water, hydrocarbons, aqueous solutions, ammonia, CO_2, toxic and inflammable gases, lutings in plugs.
EQUIPMENT: Threaded joints, flanges and gaskets, nuts, caps, valves, plug valve stems and seats, safety fuse plugs, screwed fittings, pumps, cylinder heads, boilers, compressors, stills, tanks, towers, gas stoves, etc., etc.
One "easy-spread" application and your sealing job is done—for sure, for years! John Crane new lead seal is plastic: will not set or seize nor harden under temperature extremes. Joints may be broken after years of service and remade without scraping. Protects threads, eliminates corrosion. Prevents scoring and galling. Adjusts to all clearances. May be applied to cork, paper, asbestos, copper, aluminum, lead, steel . . . John Crane Insoluble Plastic Lead Seal is a scientific laboratory formula made from pulverized metallic lead carried in a special vehicle: smooth, easy-spreading, fast-flowing. It is chemically pure: no red lead, clay filler or dope. An insoluble lubricant as well as a seal . . . Send for prices, sample and literature. Packed in 1, 3 and 5 pounds ready for use.
CRANE PACKING COMPANY, 1800 CUYLER AVENUE, CHICAGO
Branches: Baltimore, Boston, Buffalo, Cleveland, Dallas, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Tulsa
Crane Packing Co., Ltd., Hamilton, Ontario, Canada
Branches: Montreal, Toronto, Vancouver
JOHN CRANE
PLASTIC LEAD SE
Extensively used by
LEADING AIRPLANE BUILDERS

A COMPLETELY NEW PNEUMATIC TRANSMITTER

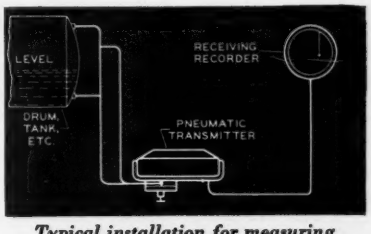
For Measuring Flow and Level

A new metering device operating on the Force-Balance Principle

The Republic Differential Pressure Transmitter.



Typical installation for measuring flow.



Typical installation for measuring liquid level.

Republic announces an entirely new type of pneumatic meter which has been thoroughly field tested during the past two years. The Republic Differential Pressure Transmitter is a simple pneumatic device for converting a differential pressure, such as is produced by the flow of a fluid through an orifice or by liquid level in a vessel, into an air pressure which varies proportionately with the differential pressure.

This air pressure is used as a direct measure of the differential pressure and can be conducted to a remote location by means of tubing. A gage or receiver connected anywhere in this transmission line will show the variations in the differential pressure and may be graduated in terms of the flow or level which it represents. The pressure can also be utilized as the impulse for actuating a controller.

RANGES—standard ranges are available from 0.9 in. to 25 in. of water differential, for working pressures up to 15 psi.; 7 in. to 50 in. of water for working pressures up to 25 psi.; and 13 in. to 800 in. of water for working pressures up to 600 psi. Special heads can be provided for working pressures up to 2000 psi.

ACCURACY of the Republic force-balance method of measurement is higher than can be consistently secured and maintained with any other method. Transmitting pressure vs measured differential is guaranteed within ½ of 1% of meter range.

SENSITIVITY—due to the negligible motions required for complete operation of all parts for full scale change, no appreciable hysteresis results from reversal of direction of measurement change. The hysteresis loop is so small that it is undetectable by ordinary means, being less than 1/20 of 1%.

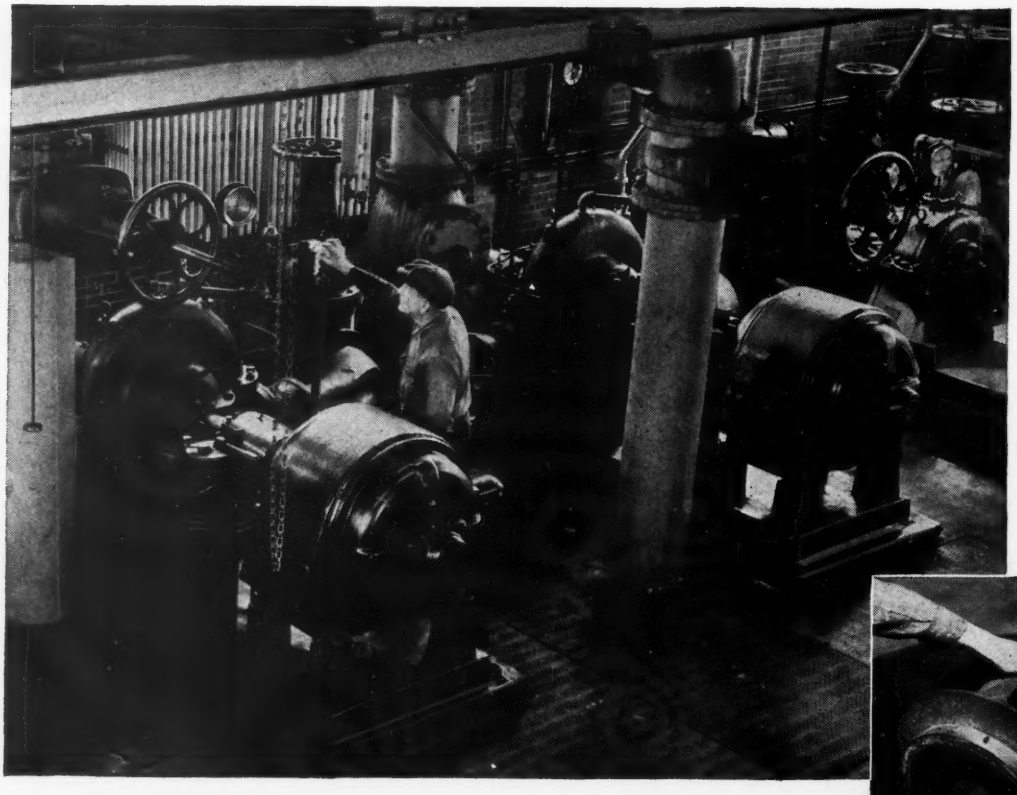
RESPONSIVENESS—due to the fact that there is virtually no volume displacement, the Republic Pneumatic Transmitter is able to follow flow changes almost instantaneously. The time required to produce full output pressure at the transmitter is in the nature of fractions of a second, after the differential is imposed. Therefore a receiving instrument installed adjacent to the transmitter will show flow changes almost instantly. With 500 feet of ¼ in. O.D. tubing, the full value of the change will have registered on a Republic receiver in 15 seconds. This is the overall lag in the system not merely, the transmission lag.

For complete data write for Bulletin No. 43-4

REPUBLIC FLOW METERS CO.

2224 Diversey Parkway, Chicago, Illinois

200% EXTRA IMPELLER LIFE TO DATE



USED IN PUMPS *that range in capacity from 3500 to 9500 gallons per minute, impellers of strong, tough, corrosion-resistant cast Monel outlast former impellers by more than 3 to 1. (The wearing sleeves on the pump shafts are cast "H" Monel and forged "K" Monel.)*

Hunt's Point Engineers use Monel to withstand highly corrosive action of sewage-laden sea water

Corrosion-*plus* was an operating headache at the Hunt's Point Plant of the Consolidated Edison Company.

The water for cooling the hot gas must come from New York's East River.

But into this drains one of the city's main sewage outlets, ten feet in diameter, constantly spewing out a flood of waste right beside the plant.

The circulating pumps must handle as much as 25,000 gallons of this polluted salt water a minute. At first, impellers never averaged more than 18 months of service.

Then, more than 6½ years ago, the first Monel impeller was installed.

Additional Monel impellers have been installed in three other circulating pumps at the Hunt's Point plant. The average life of all the Monel impellers is over 4½ years . . . 3 years more than the average working life of the former type.

* * *

Monel is the logical metal for use in applications requiring *high resistance to erosion and corrosion.* In addition, Monel is *strong* and *tough* . . . plus properties that uniquely fit Monel for service where a combination of all three properties is essential.

Today, Monel is reserved for applications essential to war production. After the war, it will be again available for general use in long-lived, economical power plant equipment. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL
"KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet-Strip-Rod-Tubing-Wire-Castings

● Ladish flanges play an important part in guarding many of the nation's pipelines.

As America's largest producer of forged steel flanges, we manufacture a complete line in sizes from ½" through 24" and in pressure ratings ranging from 150 to 2500 p.s.i.

ARMY E NAVY

FITTINGS DIVISION

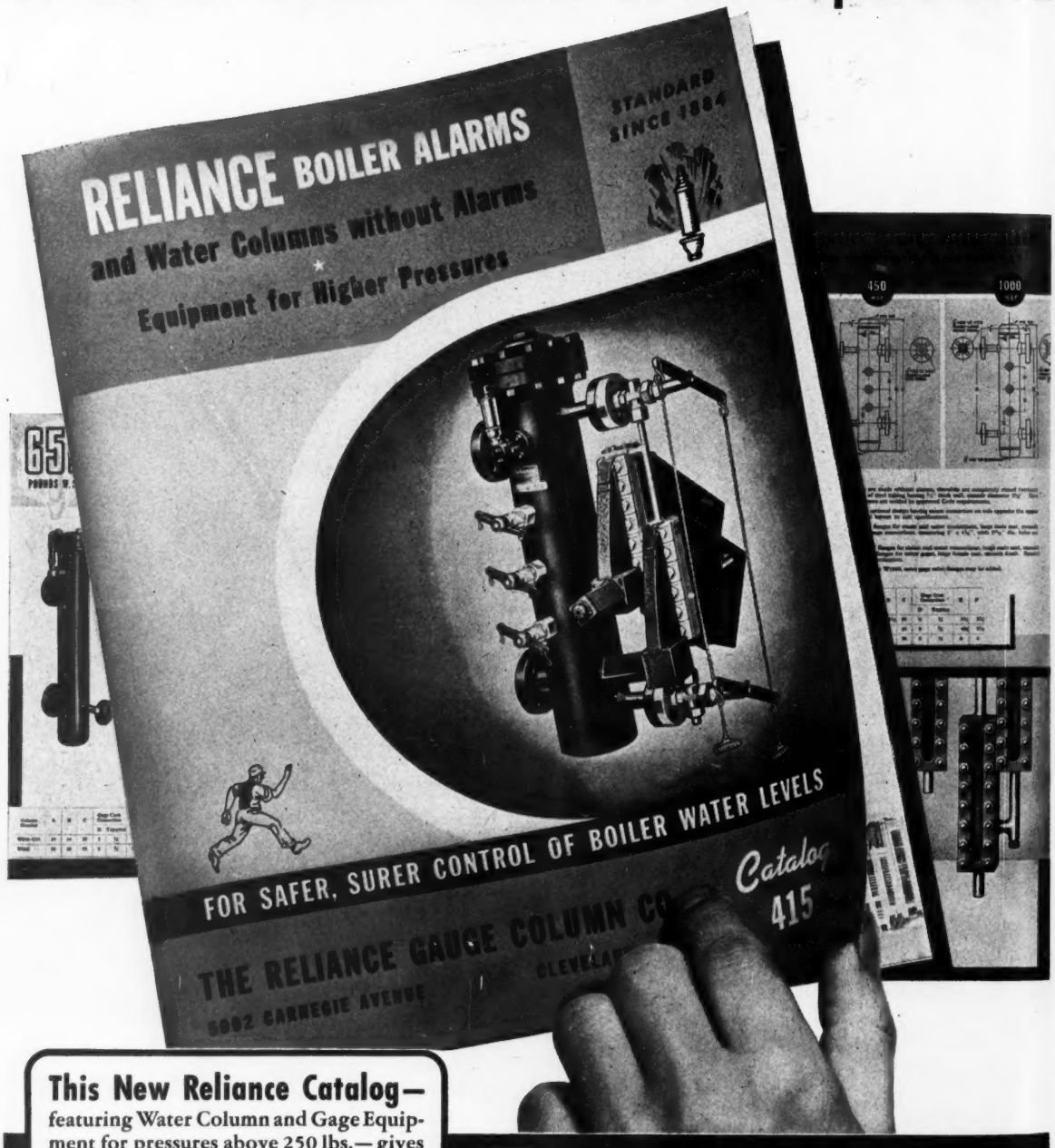
TO MARK PROGRESS

LADISH DROP FORGE CO.

CUDAHY [MILWAUKEE SUBURB] WISCONSIN

Looking Ahead

To Better Boiler Water Level Supervision



This New Reliance Catalog— featuring Water Column and Gage Equipment for pressures above 250 lbs.—gives you helpful data for your future power plant remodelling or expansion plans. Write on your company letterhead to The Reliance Gauge Column Company, 5902 Carnegie Ave., Cleveland 3, Ohio.

1884-1944

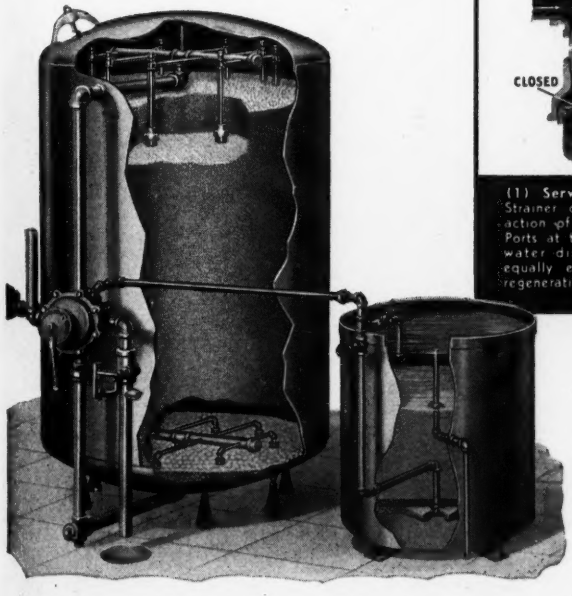
Reliance

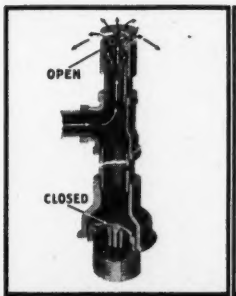
BOILER SAFETY DEVICES

44% MORE CAPACITY!

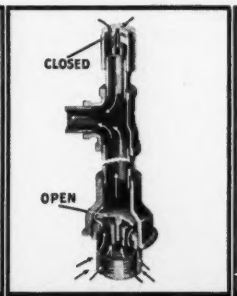
That's the remarkable record of the Improved Elgin "Double-Check" Water Softener

The improved "Double-Check" manifolds are shown in the cutaway view of the Elgin Softener below. Close-ups at right explain operation.





(1) Service position. Strainer closed off by action of lower check. Ports at top give even water distribution — equally effective when regenerating.



(2) Backwashing. Strainer now open. Greater part of wash water passes through it; balance through small ports in top. This flushes out foreign matter without zeolite loss.

(3) Lower strainer nozzle. Section through strainer shows shape of slots which prevent loss of zeolite when softening and gives free action when backwashing.

THE already well-established Elgin "Double Check" Water Softener has now been further improved to provide ever greater softening capacity and efficiency. Illustrated above is the improved "Double-Check" type manifold. It permits the use of a far deeper zeolite bed by preventing zeolite loss.

More zeolite naturally means more soft water output. The 44% increase in capacity headlined above is not the exceptional case, but is fully confirmed by a *long list of users* whose names are available to you.

Since the zeolite cannot escape, higher backwashing rates are possible with the "Double-Check" equipment. Better backwashing cleans the softener thoroughly and prevents packing and channelling. As a result, the brine reaches every grain of zeolite, giving better regeneration with less salt consumption.

If you are planning the installation of zeolite water softeners for power, process or general applications, don't overlook the added capacity and economy of this improved design.

THE "DOUBLE-CHECK" ALONE—

- **Delivers up to 44% more soft water**
- **Prevents loss of zeolite**
- **Cuts salt consumption**
- **Permits more thorough backwashing**
  ("Double-Check" manifolds can be installed in any make softener)

STEP UP THE CAPACITY OF YOUR PRESENT WATER SOFTENER!

— the "Double-Check" manifold and Elgin high-capacity zeolite will do it.

The "Double-Check" manifold arrangement can be quickly installed in place of the ordinary manifold system of any make water softener to provide the above features. Immediate delivery can be made on any type zeolite required for refill purposes. Let us show you how economically these Elgin modernization steps can give you that much-needed extra capacity.

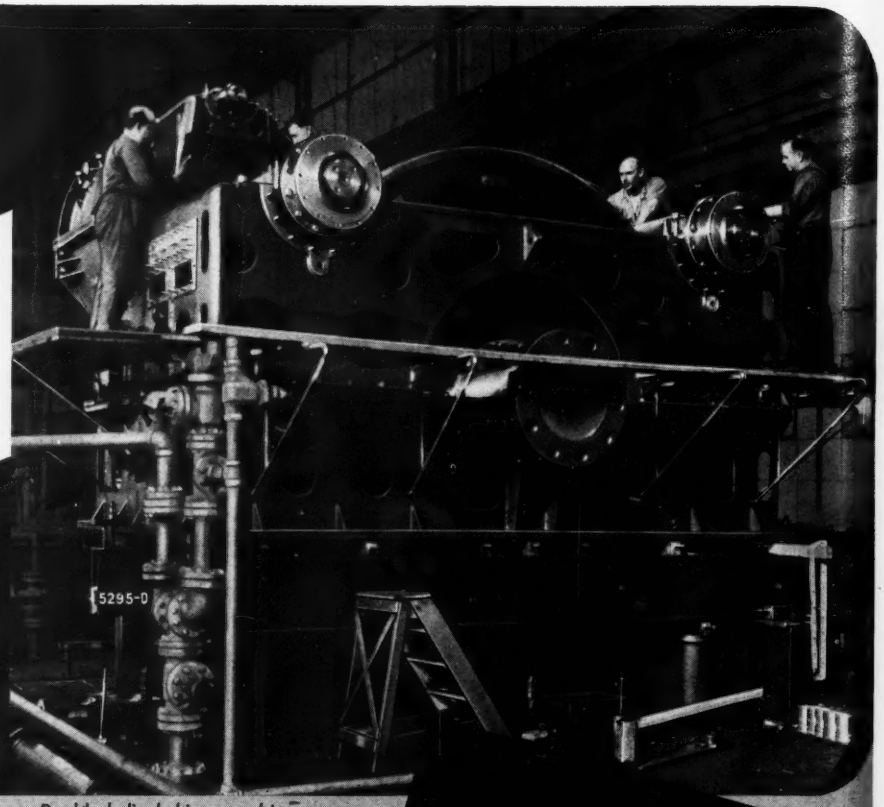
OTHER ELGIN PRODUCTS

- ▶ Boiler Water Conditioning Systems
- ▶ Deconcentrators
- ▶ Continuous Blowdown Systems
- ▶ Filters and Purifiers
- ▶ Oil Removal Filters
- ▶ Aerators
- ▶ Chemical Feeders
- ▶ Water Treating Chemicals
- ▶ Water Testing Equipment

Write for Bulletins

ELGIN SOFTENER CORPORATION
136 North Grove Avenue, Elgin, Illinois

PARTS ARE GAGED *before and after* THE TEST RUN



Double helical ship propulsion gear on test floor at the De Laval Works

In the De Laval Works each part of a machine is manufactured to limit gages on an interchangeable basis and then, after assembly, the complete pump, compressor, steam turbine or gear is tested under operating conditions to make sure that performance guarantees are met and that the unit is mechanically perfect.

Following the test, the machine is taken down and the parts carefully scrutinized and gaged again, in order to detect any deviation from normal.

This practice and policy insures that the purchaser will in every instance receive a correctly built and perfectly operating machine.

M-30

De Laval STEAM TURBINE CO.
TRENTON 2, N.J.

MANUFACTURERS OF TURBINES... STEAM, HYDRAULIC; PUMPS... CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS... WORM, HELICAL; and FLEXIBLE COUPLINGS

POST-WAR PLANNERS—

. . . Here Are Other Warren Pumps That are Headed For The Top

WARREN SINGLE STAGE • DOUBLE SUCTION

CENTRIFUGAL PUMPS

TYPES DB AND DS

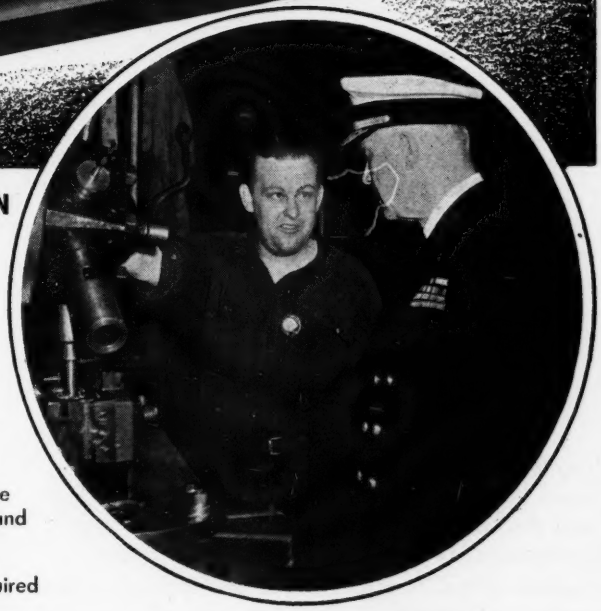
As an initial insight into the character of these Centrifugal Pumps, here are a few of their specifications:

Casing: — Close-grained, high test cast iron of the double suction, volute type divided on the horizontal center-line.

Impeller: — Gun bronze composition and of the double suction, enclosed type, accurately machined and balanced to insure freedom from vibration.

Shaft: — Ample diameter to safely transmit required power without undue bending and twisting.

Shaft sleeves, case rings, bearings, stuffing boxes, packing glands and all other features of design and construction are all completely in line with Warren's policy of "No Compromise on Quality". Write for further information or bulletins regarding these Warren Centrifugal Pumps.



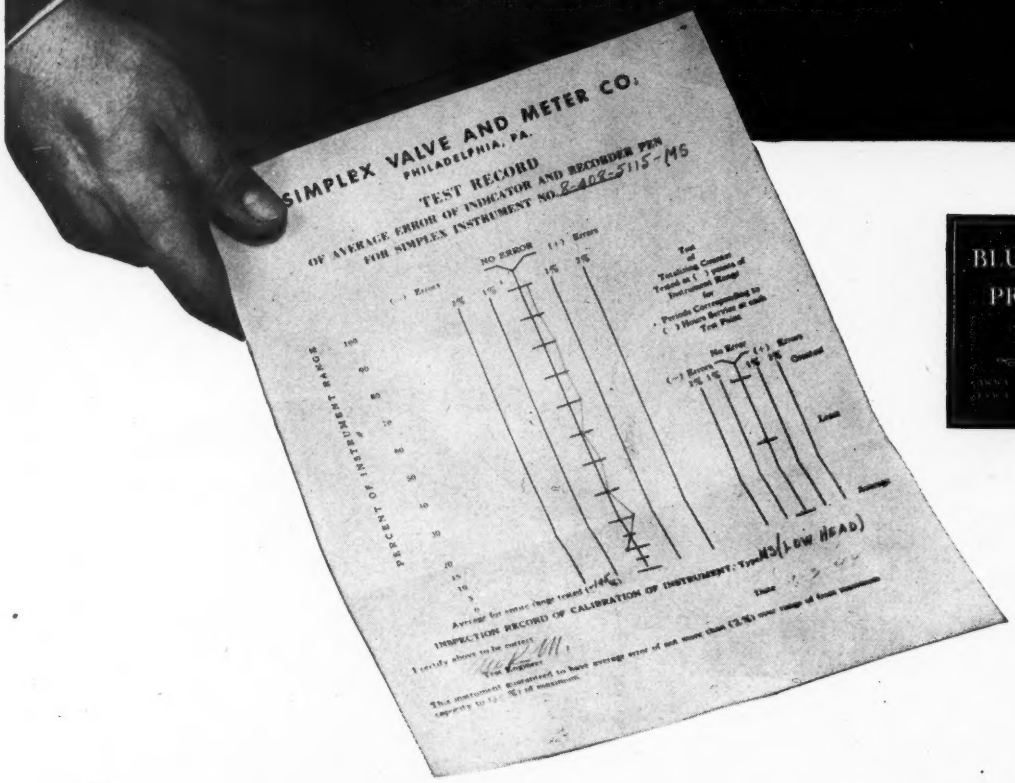
A Warren employee talks with an admiral about the Warren "E" Award. *All* Warren employees take great pride in the Warren Tradition for reliable, economical performance in peace times . . . and Warren's "service to the end" Tradition in war times.

ARMY E NAVY

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

Every SIMPLEX FLOW RATE METER IS TESTED OVER THE ENTIRE RANGE OF THE INSTRUMENT


SIMPLEX VALVE AND METER CO.
PHILADELPHIA, PA.
TEST RECORD
OF AVERAGE ERROR OF INDICATOR AND RECORDER PEN
FOR SIMPLEX INSTRUMENT NO. 8408-5115-M5
NO ERROR
PERCENT OF INSTRUMENT RANGE
INSPECTION RECORD OF CALIBRATION OF INSTRUMENT: Type M5 (LOW HEAD)
Date

Special hydrostatic testing equipment and production laboratory engineers plot a full accuracy curve of every Simplex Meter before it is shipped — and the curve showing the average error for each instrument is sent to the purchaser for his use.

Incremental differential heads are applied to the meter at predetermined percentages of capacity. By means of micrometer adjustment, the exact height of the water column is controlled within the narrowest limits.

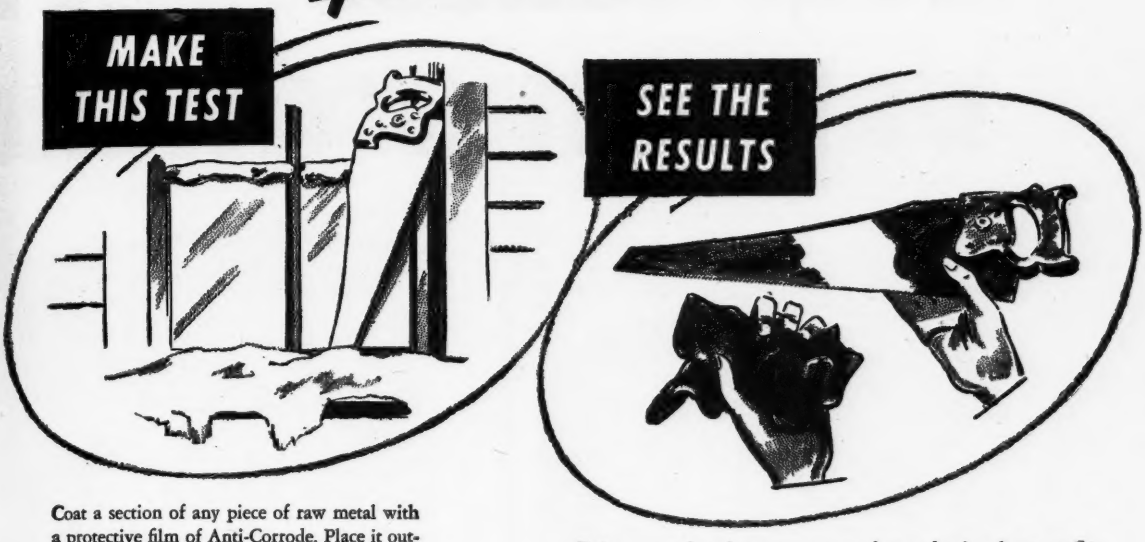
This complete routine testing procedure is the final stage of production in the Simplex plant — your assurance that every Simplex Meter is not only accurate within the entire range of the guarantee, but is also specifically tested and inspected over its entire range before being shipped.

Write today for latest literature on Simplex Meters for use in accurately indicating, recording and totalizing rates of flow of liquids and gases encountered in the water, sewerage, process or power fields.

SIMPLEX VALVE & METER COMPANY

6783 UPLAND STREET, PHILADELPHIA 42, PA.

How to *prevent* Corrosion



Coat a section of any piece of raw metal with a protective film of Anti-Corrode. Place it out-of-doors, and leave exposed to the elements.

Rain, snow, changing temperature, dust and grime have eaten into and oxidized the unprotected metal. But note surface under Anti-Corrode film—bright and unharmed, in its original state.

CITIES SERVICE **ANTI-CORRODE** is a safe rust and corrosion preventive that brings amazing results. It is a reliable safeguard against corrosion of metals in any form or state of finish—whether in storage or in transit. Anti-Corrode forms a tenacious, durable film that is impervious to moisture and the more common gases prevalent in the atmosphere. And, since it contains lubricating material, it need not be removed in drawing operations. Anti-Corrode is made in several grades to meet specific requirements and severest tests. It is economical, easy to apply and can be removed with kerosene or any petroleum solvent.

This TEAM Will Save You Money and Materials

Recently, we announced the development of Cities Service Rust Remover, and responses to the demonstration offer far exceeded our expectations. Rust Remover, of course, *removes* rust. Anti-Corrode is designed to *prevent* rust and corrosion. Together, they will safeguard your equipment and war production—for the duration!

Take advantage of this FREE ANTI-CORRODE demonstration offer
Mail this coupon today!

(Available only in Cities Service marketing territory EAST of the Rockies.)

CITIES SERVICE OIL COMPANY
NEW YORK • CHICAGO
ARKANSAS FUEL OIL COMPANY

CITIES SERVICE OIL COMPANY
Room 141, Sixty Wall Tower, New York 5, New York

Gentlemen: I would like to test Anti-Corrode on my own equipment FREE OF CHARGE. Please send me the details.

Name_____
Company_____
Address_____
City_____ State_____

Coal Conservation
DETROIT STOKERS

WAR DEPARTMENT
DETROIT ORDNANCE DISTRICT
1832 NATIONAL BANK BUILDING
DETROIT 32 MICHIGAN

1 November 1943

TO INSURE PROMPT ATTENTION
IN REPLYING REFER TO
Ltr to 675/2210
ATTENTION OF

Detroit Stoker Co.
Monroe
Michigan

Gentlemen:

The War Production Board is sponsoring a broad conservation program to conserve coal, petroleum products, transportation, electricity, water, manufactured and natural gas, and communications. Newspapers, magazines and the radio are being used to advertise the necessity for eliminating all waste and unnecessary use of these vital commodities.

The Ordnance Department is interested in extending every possible cooperation in this effort and would like to urge that your company, as a producer of Ordnance Materiel, do everything it can to help in this worthwhile campaign. This will not only assist in the War Effort, but undoubtedly will also effect actual savings in your operating costs. Although the savings in a single home or plant may seem small, the possible aggregate savings nationally are tremendous in terms of manpower, fuel, material and equipment, all of which are vitally needed in war production.

Yours very truly,

A. B. Quinton, Jr.,
Brigadier General, U. S. A.,
District Chief.

A letter from the War Department on the subject of Coal and Fuel *Conservation.*

Every possible effort must be made to conserve fuel. Conservation makes worthwhile savings in operating costs.

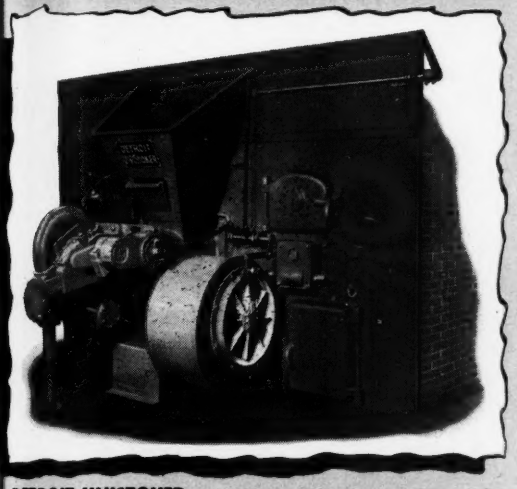
One of the best ways of conserving fuel is right under the boiler—by improving the *combustion.*

Detroit Stokers have a long record of fuel economy in all kinds of plants.

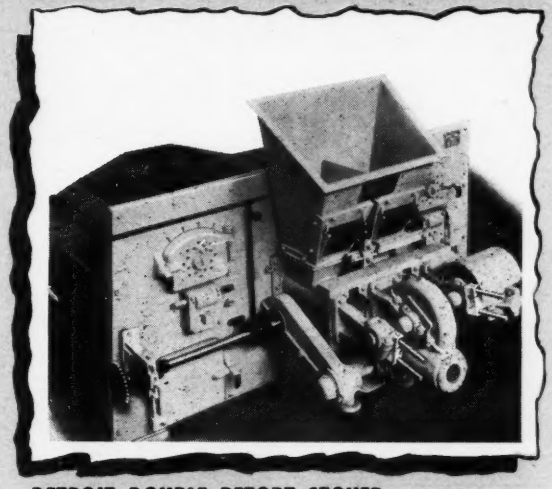
They have an exceptional reputation for dependability. Write us for our recommendation. Ask for Bulletin 524.

is a Vital Need...

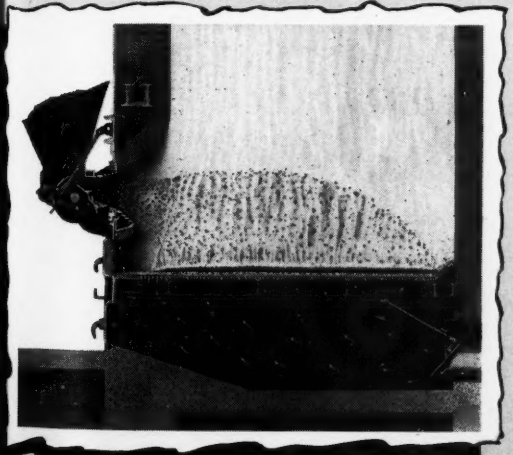
CONSERVE COAL



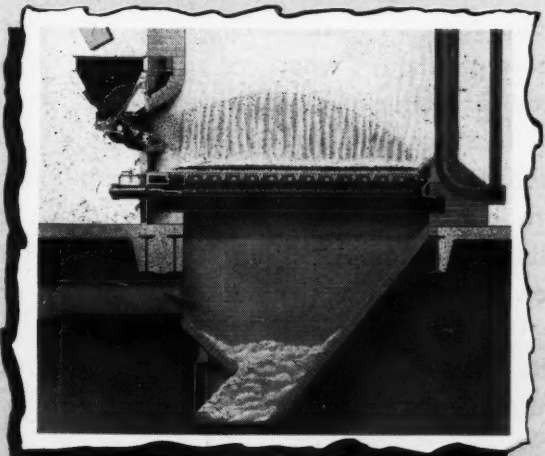
DETROIT UNISTOKER—(With Detroit Adjustable Feed) Single Retort, mechanically driven, unit type, operated by either electric motor or turbine. For 125 to 300 Horsepower Boilers.



DETROIT DOUBLE RETORT STOKER—Multiple Retort Stoker having two Retorts, with the side cleaning feature. Built in several sizes, for boilers having wide furnaces.



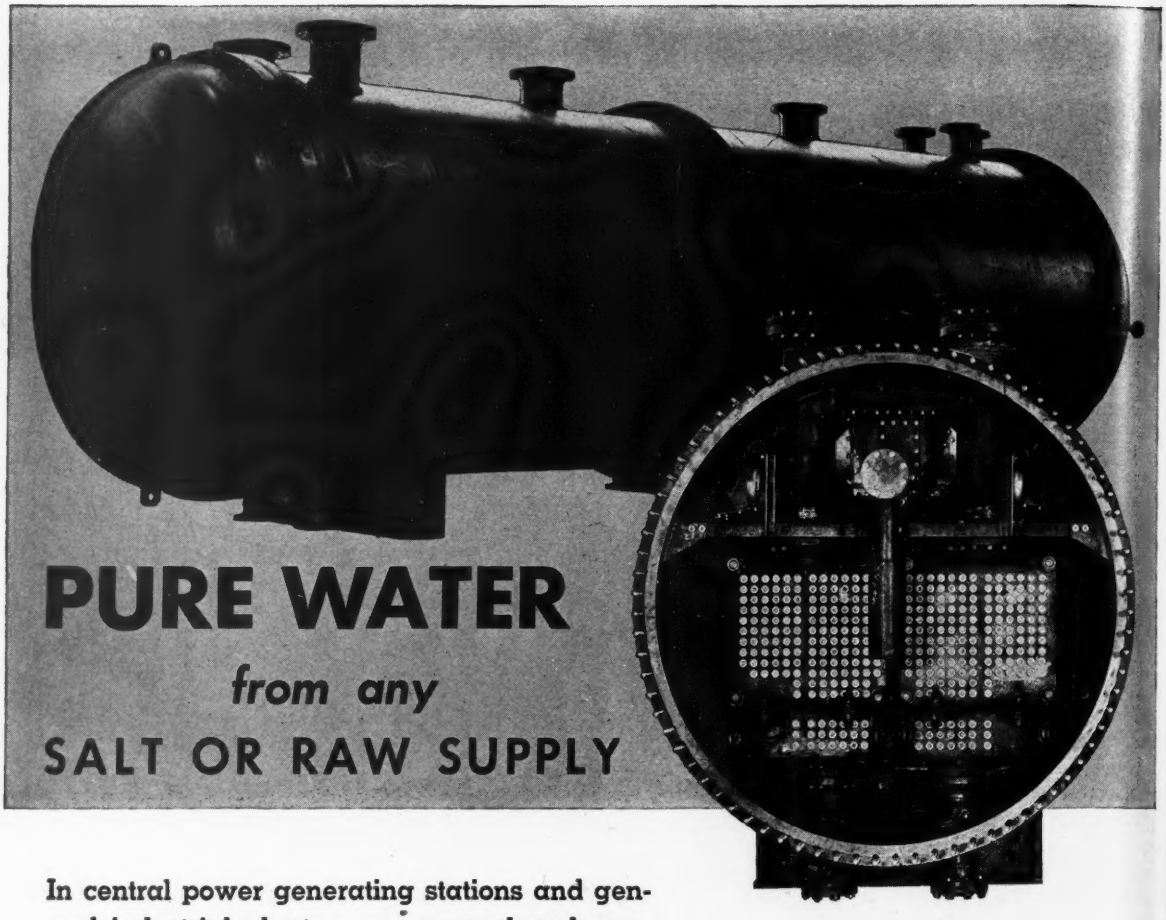
DETROIT ROTOSTOKER (Stationary Grate Type) Spreader Stoker. Burns fine coal in suspension, coarser coal or refuse on the grates. Over-throw Rotors insure uniform fuel distribution. For medium boilers.



DETROIT ROTOSTOKER—(Power or Hand Dumping) Over-throw Rotors and even distribution. Discharges the ash into the pit or basement below. For medium or large power boilers.

DETROIT STOKER COMPANY General Motors Bldg. Detroit, Michigan

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario



PURE WATER

from any

SALT OR RAW SUPPLY

In central power generating stations and general industrial plants . . . on naval and commercial vessels . . . in refineries and chemical process plants . . . wherever pure water is required for boiler feed make-up, process work, or general services . . . G-R Evaporators have established records for dependable, economical operation. These units do not require hand-scaling, and can be maintained by unskilled labor. Varying raw water conditions do not affect the product under wide limits. The distillate produced meets the exacting purity requirements of present day practice.

Look into this G-R BENTUBE EVAPORATOR

Note the rugged construction, unusually large clearances, and widely spaced tubes. The heating surface of this unit consists of patented scale-shedding Bentube elements. Temperature variations change the curvature of the tubes, thereby shedding the scale. G-R Bentube Evaporators can be furnished for large or small capacities, and in single or multiple effects for any requirements.

THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

A New Type of Ship Follows Her ...with the Same Type of Diesel

Below is a picture of the U. S. Maritime Commission ship American Manufacturer. She is one of the C-1 vessels propelled by Busch-Sulzer Diesel engines. The C-1's are giving a good account of themselves, delivering war cargoes on fighting fronts the world over.

Now a new type of Maritime Commission vessel will carry the battle to the enemy—the C1-MAV-I. Busch-Sulzer is proud, of course, that its Diesel engines on C-1 ships made a reputation that has earned them the privilege of powering the new vessels. That reputation stems from nearly half a century of producing Diesel power noted for low operating cost, low maintenance cost and reliability. These factors will be offered to you when Victory ends our present schedule of 'round the clock production for the Army, Navy, Maritime Commission and high priorities only.

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AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 2

"Phosphorized Admiralty"—and its dezincification-resistance

The qualities of this condenser tube material as confirmed in actual performance and reported by Scovill engineers

Millions of pounds of Phosphorized Admiralty are now in use in heat exchanger and condenser service — some since 1939 when this Scovill material was first introduced. Phosphorized Admiralty has built up a remarkable performance record and its resistance to dezincification is of a high order.

An explanation of this may be of interest.

The *dezincification-resistance* of Phosphorous bearing brasses is well known.

The *marked influence* of a very small percentage of Phosphorous in controlling this form of corrosion of Brass has been the subject of considerable research. In this connection, much interest has been shown not only in the actual ability of Phosphorized Admiralty and other phosphorized brasses to inhibit dezincification but in the reasons for the beneficial effect imparted to such alloys by Phosphorous.

Several theories have been advanced and much investigational work has been carried out to explain the inhibiting action of Phosphorous in brasses under service conditions which would normally result in dezincification of the metal. This problem will be better understood by a consideration of the properties of Phosphorous and its compounds.

Phosphorous is non-metallic in character and enters into combination with Oxygen to form a series of oxides. From Phosphorous and its various oxides, a number of metal salts may be obtained. With the exception of Sodium and Potassium salts, these metal compounds are, in general, insoluble in water. In some cases, these salts exhibit colloidal properties to some degree. The end product of the oxidation of Phosphorous gives ortho-phosphates and, in the presence of sufficient Oxygen, ortho-phosphates will be found.

One interesting detail in connection with the compounds of Phosphorous is the behavior of Tin and Phosphorous when they are present in the same solution. Tin Oxide in colloidal solution readily takes up or absorbs Phosphates and this reaction usually hastens the precipitation of Tin in a very insoluble form. It was earlier believed that this reaction was entirely of a colloidal nature, but, recently, it has been shown that a definite compound of Tin Phosphate is formed, at least in certain conditions. This particular reaction between Tin and Phosphorous compounds is stressed because it has been noted in a research on the dezincification of brasses that the presence of Tin in itself retards dezincification to some extent; but the addition of Phosphorous (as in Phosphorized Admiralty metal) is necessary to prevent dezincification of the alloy.

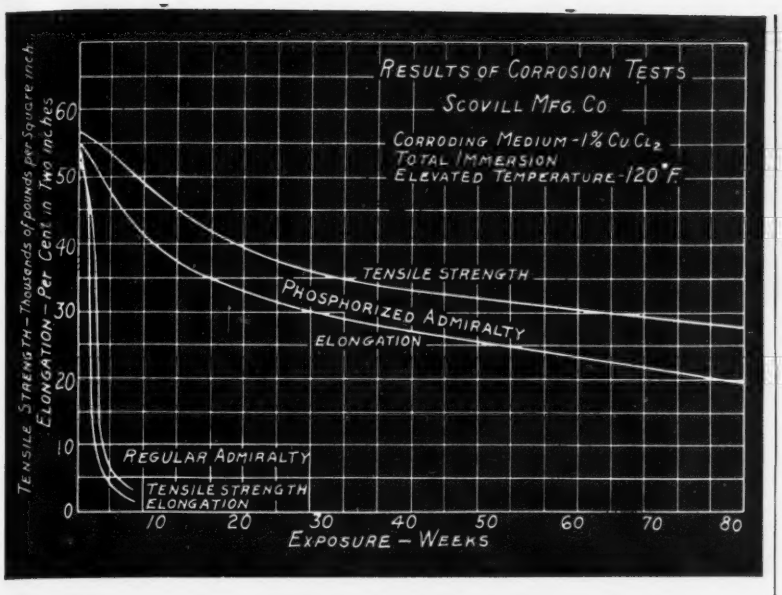
If the foregoing discussion of the formation of insoluble and colloidal metal salts of Phosphorous is remembered, the dezincification-resistant property imparted to Brass by the addition of Phosphorous can more readily be explained. In services where dezincification of Admiralty metal or other brasses has been experienced, the phosphorous content of the dezincification-resistant alloys probably promotes the formation of a protective film (in the nature of a metal phosphate or phosphide such as Copper Phosphide Cu_3P_2), which coats the metal surface at initially corroded areas and arrests further action at such areas.

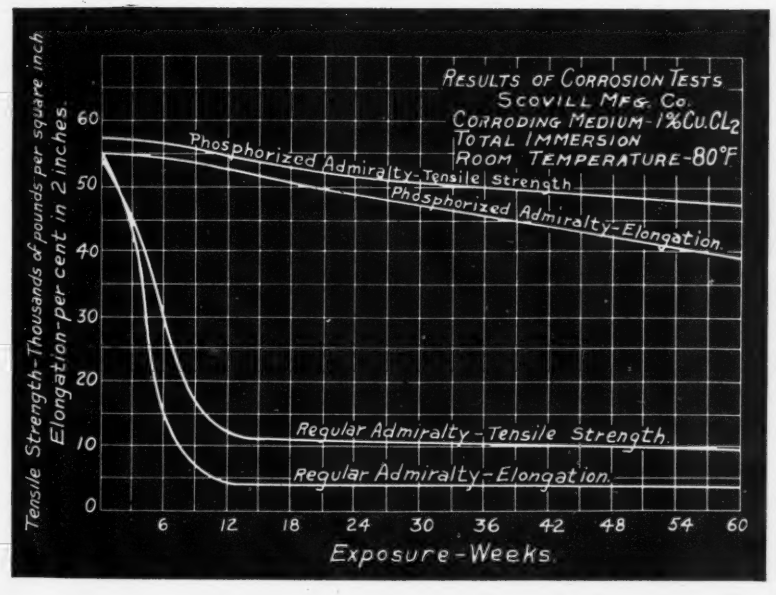
The reactions which take place in the formation of the phosphorous containing film may or may not be complex in nature, as may be anticipated from the above remarks on the chemical reactions of Phosphorous. Thus, in the early stages of corrosion, Phosphorous, together with Copper, Zinc and Tin may pass into solution and the Phosphorous may then combine with certain of the metal ions in solution to form an insoluble compound which coats the metal surface as a stable impervious film. The formation of this compound may involve nothing more than introduction of ions of the reacting elements into the solution, followed by precipitation and deposition of certain combinations of such ions on the metal surface.

It is probable, however, that a more complex series of reactions takes place and may be better explained by considering the existence of colloids in the medium in contact with the metal surface. In this connection, it may be pointed out that very minute quantities of colloids in a solution often times produce a profound change in the behavior of such solutions. In the plating of metals, for example, colloids in the plating bath may alter the type of plate, may prevent plating altogether, or may change the conditions (current density, voltage, etc.) at which satisfactory plating may be carried out. The subject of plating is introduced in this discussion of colloids because dezincification may be looked upon as a plating operation in which Copper is plated upon the brass, usually in the form of a porous, brittle mass. In the case of Phosphorized Admiralty tubes, colloidal Tin Phosphate or other metal phosphates may play an important part in preventing dezincification of the alloy.

This discussion of the part which Phosphorous plays in preventing dezincification of Admiralty metal and other Brasses has necessarily been brief and has been presented only because of the interest which has been shown in this subject.

Wherever dezincification of Admiralty metal tubes has been a serious corrosion problem, the use of Phosphorized Admiralty metal tubes is suggested. This alloy combines the general excellent corrosion-resistant properties of Admiralty metal, a desirable fine grain structure of




RESULTS OF CORROSION TESTS
SCOVILL MFG. CO.
CORRODING MEDIUM - 1% Cu.Cl2
TOTAL IMMERSION
ROOM TEMPERATURE - 80°F.
Phosphorized Admiralty - Tensile Strength
Phosphorized Admiralty - Elongation.
Regular Admiralty - Tensile Strength.
Regular Admiralty - Elongation.
Tensile Strength - Thousands of pounds per square inch.
Elongation - per cent in 2 inches.
Exposure - Weeks.

developed primarily for oil refineries and gasoline plants because in those places the phenomenon of dezincification is pronounced and widespread, it is equally applicable to any situation where dezincification of Admiralty is a problem — particularly at elevated temperatures.

"Phosphorized Admiralty tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by the owner of this Scovill Manufacturing Company patent, or one of its licensees.

Scovill Offers 3 Services to Tube Users

1. Information, like that appearing on these pages, which will help keep engineers informed of recent developments and recent thinking in the matter of condenser tubes. The new "Condenser Tube Booklet" — a part of Scovill's *Service in Manuals* is available, free, from Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Connecticut.

2. Research in Metals is another Scovill service, intended to establish new knowledge about metal alloys which will help develop better performance on the part of Scovill condenser tubes. Scovill *Service in Metals* also includes the testing of raw materials, the testing of finished tubes before shipment and the analysis of problems arising from tubes in service.

3. Individual recommendations for each customer's requirements constitute the third Scovill service. *Service in Men* brings you a wealth of experience to help you obtain the best results and to eliminate trouble causes.

the finished tubes, favorable physical properties and a very definite improvement over Admiralty metal in its very marked resistance to dezincification.

While Phosphorized Admiralty was

ARMY E NAVY

Limitation order L-154 issued by the OPM, limits the use of nonferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No nonferrous metals containing more copper and more tin than these two are permitted by the order.

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MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

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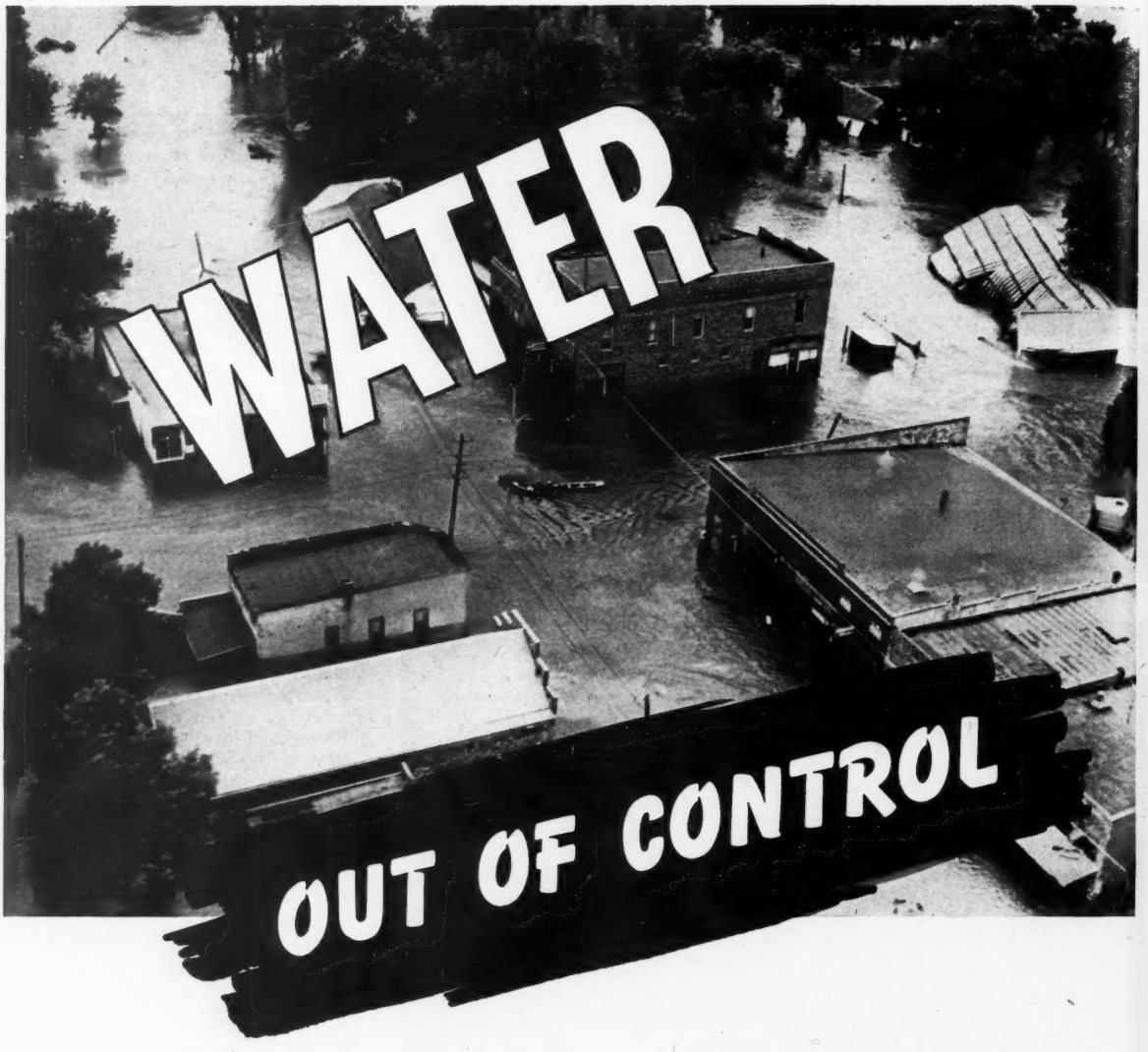

● Flood water is not the only "water out of control" which can leave crippling damage, irreplaceable loss or financial ruin in its path of destruction.

Water . . . uncontrolled . . . carried to vital spots in your plant, can ruin vital power plant equipment, play havoc with your production schedules or waste precious fuel.

Today, as never before, modern water conditioning is a "must" control against destruction by scale corrosion, embrittlement, carry-over, oil, etc.

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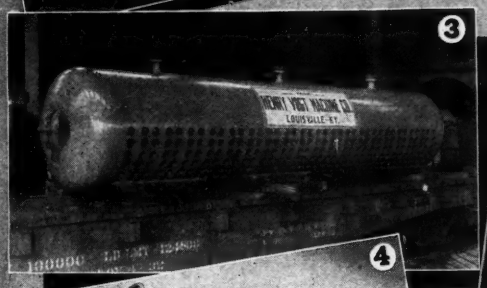
WELDED PRODUCTS by Vogt



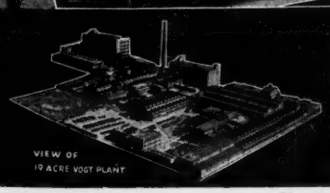
1 - 4′—0″ dia. x 7′—6″ dia. x 82′—5″ high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

2 - Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

3 - 48″ dia. x 22′—6″ long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

4 - Battery of Absorption Columns in a Western Refinery. Units are 33″ dia. x 41′—0″ high and were stress relieved after welding.

5 - 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.



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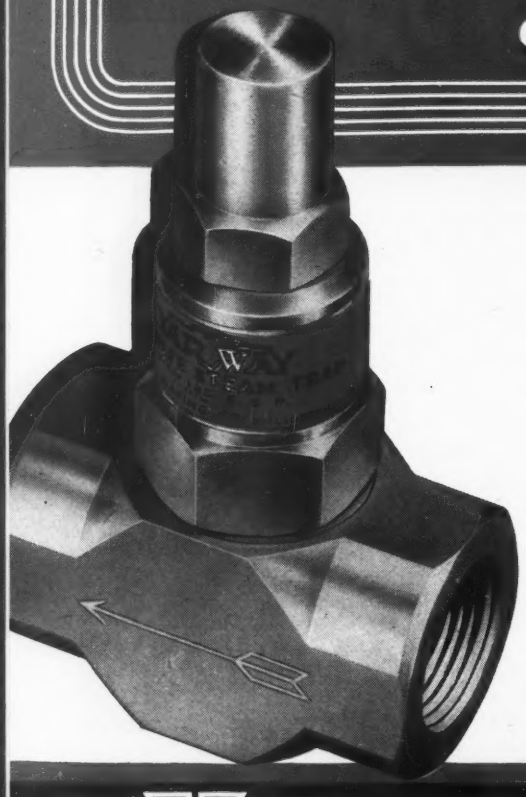

"WHY use a bulky steam trap, when a little Yarway Impulse Trap will handle the job just as well, if not better?" asks Chief Engineer O. L. Moody of Baker Hotel, Dallas.

And Mr. Moody adds, "We have been using Yarway Traps for years on kitchen equipment, in the boiler room and laundry. Their efficient service, simplicity of design, sturdy construction and small size appeal to us. Should we need more traps, they'll be Yarways."

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You may be surprised to find that it will cost no more to replace with Yarways than to repair old, ordinary traps. It's often the case, so why not get Yarway service for your money?

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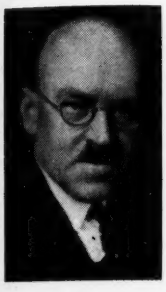
YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

The Engineer as Planner

By RALPH E. FLANDERS



SOME TEN YEARS or so ago it chanced that I appeared at a round-table discussion at which another participant was one of the leading economists of the country. My economist friend remarked that the worst thing that could happen to the country was to put its economy in the hands of engineers.

This seemed at the moment like an uncalled-for criticism of the abilities and usefulness of our profession and, as can be imagined, I was up in arms at once.

When, however, he began to expand his point of view, it began to appear as true and important. It may serve a good purpose to review that point of view even today, after the lapse of a decade of turbulent history.

It would be disastrous to apply engineering procedures directly to the control of society. It would be disastrous because it is completely unworkable to treat human beings, whether individually or in the mass, as though they were machines subject to simple, invariable, mechanical laws which can be discovered, organized, and successfully applied. However much we may discover about the causes and the nature of human actions, the control of them still remains an art rather than a science, and it certainly will remain an art rather than a science so long as any of us who are here present live and have the faculties intelligently to observe.

We are faced with the necessity for a considerable measure of planning. This necessity will be made still more clear by the difficulty of shifting our operations from the first total war in which we have ever been engaged over to a peacetime economy in which, again for the first time, we meet the opportunity of a high level of employment, production, and human satisfaction.

The problem divides itself into two parts. The first is the determination of what is economically, industrially, and scientifically possible. The second is the question of what is politically possible.

We must never forget that this second question—what is politically possible—is the ruling factor. All of us, as citizens, are a part of the influences which make reasonable procedures possible or impossible. As specialists in our profession, we have simply to realize that our usefulness is limited by the poltical conditions in which we participate as citizens. Let us turn at once, therefore, to some reflections on that area of our problem which is more nearly a science than an art.

The subject of economics occupies the middle ground between the two. It is classified as a social science. That classification in itself indicates its position midway. None of the social sciences is so clear in its relations of cause and effect, or has such clearly definable causes, that effects and results can confidently be predicted in advance. Economics itself is a study of human behavior.

Laboratory procedure is impossible. Experimentation by varying one factor at a time and observing its influence unaffected by other factors is unattainable. The laboratory is the nation as a whole and the world as a whole. The variables are numerous and complex, and they do vary beyond our control.

If this is a mechanism, its nearest approach in physical terms is to celestial mechanisms, in which there are no fixed points and only kinetic constraints on the movement of the elements. The disturbance of the movement of the smallest and most remote body affects the movement of every part.

We have discovered the complex nature of these relationships first in our endeavors in the United States to control recovery and secondly in the necessary attempt to control and direct our economy to the waging of an all-out war. Every time some apparently simple and obvious action has been adopted—for instance, in price or production control—its effects have spread throughout the whole structure and have resulted in disturbances which were unexpected, difficult of correction, and sometimes almost disastrous.

Society is not a mechanism. It is an organism. Let us never forget this. But where, in this case, shall we find the sphere for social action of the engineer?

In the first place, the whole situation demands the engineering approach. It is the role of the engineer to apply the discoveries of pure science to the practical attainment of human desires. He stands and works with one foot in each of these two worlds.

Our society has long needed this point of view and this approach. We have had the scientists working as scientists in the expansion of human knowledge. We have long had human problems crying for solution. We are now engaged in the task of building up a technique of social engineering which shall bridge that gap in the social field as the engineer has bridged it in the physical field.

A moment ago I spoke of society as an organism rather than as a mechanism. Perhaps this gives the clue to the procedure. Our most useful parallel may be between the social organism and the human organism, rather than between the social organism and the machine.

In this detailed planning for individual companies, for communities, and for whole industries, the engineers concerned have a large part to play. They are concerned with the development of new products. They are concerned with the development of their communities and the public works which are needed therein and which can furnish a reservoir of employment for times when employment is falling off. They are concerned with the broader appraisal of the future of the industries with which they are connected—whether or not new products and new methods are tending to render them obsolete or whether new opportunities are arising out of new scientific developments which should lead to expansion and redirection.

Your speaker is chairman of the Research Committee of C.E.D., which has set itself the task of developing the hygienic principles which, if applied to our society, will enable business to perform its socially usetul function. It performs the engineering office of making application of the studies undertaken by a staff of technical men and an advisory body of social scientists, to the practical problems which it has posed. This is the true engineering function applied to social problems. In my belief, it is the most hopeful project now under way in the United States for reaching a practical solution of the immensely complicated problems which will face us as the war draws to a close.

Few men in this country—or anywhere else, for that matter—have done more straight thinking about the engineer and his relation to society than Ralph E. Flanders. After serving as designer for International Paper Box Machinery Co., as associate editor of Machinery, and as engineer for Fellows Gear Shaper Co., Mr. Flanders became director and manager of Jones & Lamson Machine Co., Springfiield, Vt., in 1912, and has served with that company ever since, becoming its president in 1933. He is author of technical and economic books and studies, has been awarded degrees of ME and ScD by Stevens, Middlebury, Rose Polytechnic and other institutions and has served on many governmental and industrial technical bodies. He was awarded the Worcester Reed Warner Medal by the ASME in 1934 and was president of the ASME in 1935. Recently he was appointed chairman of the Committee on Research of the Committee for Economic Development. The material given above is from a paper delivered at a recent joint meeting of the Engineering Institute of Canada and the ASME at Toronto, as reported in Mechanical Engineering.

10-KW LAMP

IT IS DIFFICULT to believe that this little glass tube—no larger in diameter than a man's little finger—is dissipating some ten kilowatts of electrical energy. Yet, this is what it is doing. It is a new mercury vapor lamp developed by Westinghouse, rated at 10,000 watts and is so brilliant that this picture had to be taken through a special glass filter screen. Actually the tube is not glass; it is quartz and it is cooled by a continuous flow of cold water through an outer tube surrounding the inner quartz tube. Even with this stream of cooling water, however, enough heat is generated to light a cigarette held near it. Samuel Hibben, director of applied lighting at the Westinghouse Lamp Division, showed this lamp at the Waldorf-Astoria in New York during a recent demonstration of possible post-war uses of light. It produces a brilliance one-fifth that at the surface of the sun and concentrates in its less than two-foot length the light given off by 1000, 40-watt household incandescent lamps. Such lamps have yielded important data to aid research engineers in their study of color correcting mercury vapor lamps. Similar lamps in smaller sizes—up to 3000 watts—are now used to light high bays and aisles in war plants. Other lamps shown at the demonstration are shown on page 77 of this issue.

WITH THE EDITORS

OF THE MAKING OF MANY BOOKS, there is no end. Few people outside the publishing business or the library field have any conception of the tremendous amount of published scientific and technical literature that is available today. Scientists and engineers are now beginning to have trouble with this mounting volume of printed matter. There are, to be sure, some cynics who maintain that the human race is eventually going to be submerged and extinguished in a flood of little pieces of paper with numbers written on them, most of which mean absolutely nothing. (We are doing our best to keep POWER PLANT ENGINEERING from falling into that category.) In all seriousness, however, the problem of surveying the scientific and technical literature of a given field is assuming gigantic proportions.

When an engineer or scientist embarks on a research project, he should, theoretically, have such a complete knowledge of what has been published on all phases of that problem that he would spend no time in duplicating work that had been done previously. Frequently, however, the technician not only does not know how to make a proper survey of the literature but even if he did know how, the job might be bigger than the research project itself.

This problem, particularly as it arises in the chemical field, is discussed in a very interesting report entitled Problems of the Scientific Literature Survey by Gustav Egloff, Mary Alexander and Prudence Van Arsdell of Universal Oil Products Co., recently published in the Journal of Chemical Education.

According to this report, many chemists meet their first research problem with inadequate preparation for conducting literature researches in a reasonable length of time. Some are not even acquainted with the titles of the more prominent journals in their own language. Much valuable time has been wasted duplicating studies that have already been published. In addition to avoiding laboratory duplication, the review of related work may bring forth many profitable ideas.

The report continues with an analysis of the things that should be done in making a survey of the literature covering a specific problem in chemical investigation. The report then raises the question: Why are these rules necessary for a group of trained scientists? It concludes that the answer lies in the lack of fundamental training in the use of the literature for a bachelor's degree, as well as inability to foresee the outcome of carelessness in handling certain details, and of deviation from a general form. It recommends much more attention to this subject in the colleges, calls attention to the increasing importance of the scientific literature in the Russian language and concludes with this pertinent observation: "At the close of this war there will be an even greater necessity for such training, since there will undoubtedly be released for publication a tremendous volume of research which is now under secrecy orders because of its relation to the war effort."

While the situation in the power engineering field does not approach in complexity that in the chemical field, yet it is becoming increasingly clear that the job of referring to and evaluating power engineering literature is growing rapidly in importance. POWER PLANT ENGINEERING's editors receive scores of questions on all phases of power engineering. They are continually impressed by the fact that many of the questions that arise today could have been answered by the inquirer if he had had, or been able to obtain, knowledge of what has been published in various technical magazines during the past ten or fifteen years.

Another aspect of the problem is the fact that developments in so many of the fields of chemistry, metallurgy and related applied physical and chemical sciences, to say nothing of fields like electronics, are beginning to affect materially the things the power engineer can do at present and will be able to do in the future.

It is no disparagement or criticism of librarians or of the various technical and scientific indexes available today in all good libraries to say that they do not give the average engineer what he needs. The fault is more with the engineer's ability to use these facilities. If the power engineer, like the chemist, is not receiving any training in his engineering college or technical school in evaluating the literature of the field properly, that training certainly should be given him. But perhaps more could be done.

Perhaps we could set up a formal bibliography of the power engineering field. In certain fields there are institutes that form a focus for all the activities of the field. The paper industry is an example, with its institute at Appleton, Wis. In mechanical engineering the ASME is the nucleus, with its Engineering Index. Yet power engineering is but one division of mechanical engineering and many power engineers, particularly those who need most to know the power engineering literature, are unable for one reason or another to avail themselves of the ASME's resources. True, the Industrial Arts Index covers all industrial fields, including power engineering, yet how many power engineers have access to it or even know of its existence?

What the power engineer needs is a good power engineering bibliography prepared especially for his requirements. That requires time and work by a competent staff and would cost money. Would power engineers be willing to pay for it? If so, it could be established.

SPINNING RESERVE—In the description of the Harbor Steam Plant in the June issue, also in Professor Christie's splendid paper on spinning turbines in the January issue, we hope you were forcibly impressed by the emphasis on one thing you have known for years. It is that the whole response of a steam power plant to load changes depends almost entirely on the speed of response of the steam generating unit and its auxiliaries.

In the case of the Harbor Steam Plant, the single steam generating unit is designed to increase its output from 60,000 lb of steam an hour to 500,000 lb an hour in 20 to 25 *seconds*—not minutes.

In some of the very high-pressure and high-temperature stations, one factor, not often thought about, may control this speed of response. That is the thickness of metal in the boiler drum. If this boiler wall is very thick, then the temperature difference between the inner and outer surfaces of the drum must not be allowed to vary beyond a rather small value—of the order of 75 F or so—otherwise undesirable internal stresses may be set up in the metal. Hence it might take many minutes to raise boiler output through a 9 to 1 range, for this temperature difference has to be maintained throughout the range.

This condition, of course, does not obtain in the Harbor steam generating unit because of the moderate pressure. It is mentioned only to reinforce our comment that it is the boiler and not the turbine that is the primary factor in quick pick-up of load.

The turbine and electrical men can take care of their factors very well. Control engineers can design and build control equipment to coordinate the various factors. But it is the lowly boiler man—the combination chemist, accountant, steel worker and all-around hunky—who must get the steam to the turbine unit fast enough to make it do what it was intended to do. He holds the key to the whole process.

STEAM FOR—If it is important to get steam to the turbine in the proper manner to operate it as required, it is equally important to get steam to industrial processes to operate them as required. That's why you'll find, in this issue, one article entitled Steam for Dow Styrene and Goodyear Synthetic Rubber, the other Steam for the Dodge-Chicago Plant. That "Steam for—" business doesn't mean we've run out of title ideas. It means that's the story.

In both cases, large amounts of required electric power could be supplied the processes from utility systems and power pools. So, for the process heat, available low-pressure boilers were used to save fabrication, critical materials and, above all, time. In what we like to think of as normal times, the relations between steam and electrical generation in these two cases might be entirely different.

But the circumstances lead us to wonder what may happen when some of the chemists get through with us. The other day we heard a chemist discussing some ideas he is working on for power generating cycles at low temperatures, in which various liquids would replace water and steam as carriers of energy and as refrigerants in the condenser. His ideas appealed to an expert paper mill engineer who was present. Suppose, said the latter, certain methods now in use for suspending fibers in liquids other than water could be applied to pulp and paper making. Then we might not need to dry paper with vast quantities of steam. What would that do to the entire physical and economic set-up of a paper mill and particularly to the power plant?

These ideas are not fantastic in the light of what the "chemmers" and the "physickers" are now doing. However, we venture the prediction that for several years more you'll be seeing articles in the power engineering magazines with titles beginning "Steam for—"

Steam for Dow Styrene and Goodyear Synthetic Rubber

To get the synthetic rubber program under way rapidly, in a time of severe shortages of critical materials and equipment, required considerable ingenuity, especially in power plant design and construction. How power engineers did a great deal with what they could get is well illustrated in the power plant built to supply steam for the new styrene plant of the Dow Chemical Co. and the polymerization plant of Goodyear Tire & Rubber Co. at Los Angeles, Calif. Here ten marine type boilers, removed from World War I destroyers and redesigned, together with two new high-pressure boilers, were installed outdoors, only the pumps, control equipment and laboratory being housed. The marine boilers generate 50,000 lb per hr each of 200 psi saturated steam, the high-pressure boilers 25,000 lb per hr each of 450 psi saturated steam, a total rated steam capacity of 550,000 lb per hr. They are fired with either natural gas or oil and provided with natural draft concrete stacks, thus saving fan and duct materials. Electricity for the plant is purchased. A complete system of automatic boiler control is provided, with all controls and signals located in a centralized control room. Because of the high percentage of boiler make-up required, a large water treatment plant is installed. Extensive use of wood and concrete for water treating equipment, oil storage tanks, operating platforms and stairways saved much critical steel. Here, in a vital new industry, is a particularly good example of power engineering at war

AS A COMPONENT part of U. S. Government's synthetic rubber program, the boiler plant described in this article was constructed for Defense Plant Corp., The Dow Chemical Co., Lessee, at Los Angeles, by Stone & Webster Engineering Corp., for supplying process steam to the styrene plant of The Dow Chemical Co. and the polymerization plant of the Goodyear Tire & Rubber Co.

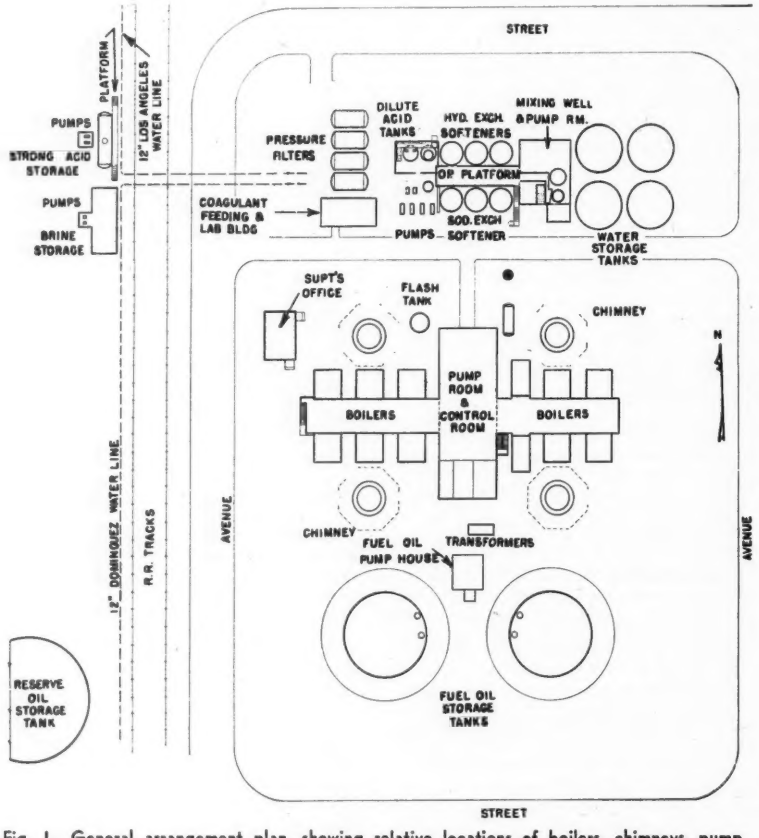


Fig. 1. General arrangement plan, showing relative locations of boilers, chimneys, pump room, control room, water treatment plant and fuel storage tanks

As the great demand for ships and war machines had brought about a shortage of equipment and materials used in boiler plant construction. While the synthetic rubber plants were urgently needed for the war effort, the policy of the War Production Board called for the utilization of used equipment and noncritical materials wherever possible in the construction of steam and electric generating plants.

In conformity with this policy, the boiler plant was designed to utilize a minimum amount of critical material by:

Installation of ten marine type boilers for 200 psi process steam requirements, redesigned for land installation; also two high-pressure boilers to supply 450 psi process steam.

Reduction of building requirements to a minimum by installation of boilers out-of-doors, housing only pumps, centralized controls, chemical laboratory and locker room.

Use of concrete and wood for building structures, water treatment equipment and tanks wherever possible.

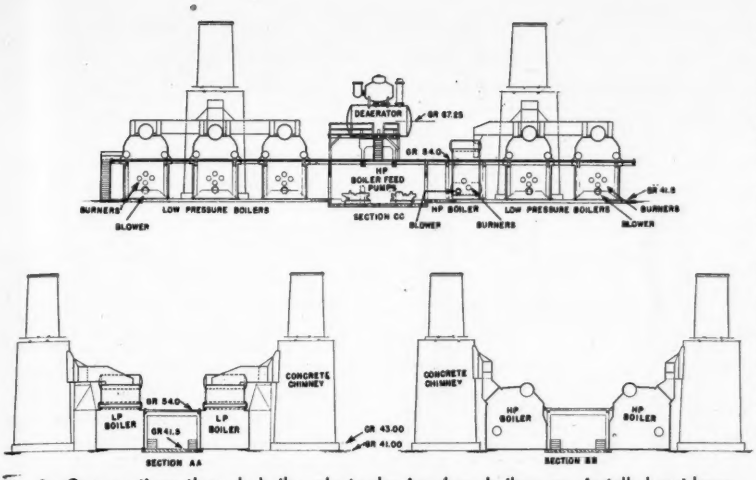


Fig. 2. Cross-sections through boiler plant, showing how boilers are installed outdoors, how concrete operating platform at Grade 54 forms pipe gallery and roof for pump and control room at Grade 40.5. Operating platform is only structure around boilers. Compare with Fig. 3

Figure 1 shows the general plan arrangement of the boilers, four concrete chimneys, pump and control room, concrete fuel oil tanks, fuel oil pump room, transformer station, office and water treating plant. All structures and equipment are designed to withstand earthquake shock.

The low-pressure marine type boilers supply saturated steam to the Dow styrene plant and the Goodyear polymerization plant. The expected demand for low pressure steam from the Dow and Goodyear plants is 200,000 and 180,000 lb per hr respectively. The 450-lb boilers supply high-pressure process steam to the Dow styrene plant.

Water for boiler feed make-up is purchased from the Dominguez Water Co. and the City of Los Angeles. Up to 90 per cent of treated water makeup may be fed to the boilers, since no condensate is returned from the Goodyear plant and only about 40 per cent from the styrene plant.

Either natural gas or fuel oil is used for firing boilers. Electric power is purchased from the local utility.

Low-Pressure Boilers

For the generation of 200-psi saturated steam, ten White Forster marine type boilers, built in 1918 and removed from destroyers, were installed. These boilers have 6875 sq ft of 1 in. diam tube surface.

This type of boiler, as originally installed on 1200-ton destroyers, was designed for 265 psi gage and rated at 100,000 lb per hr maximum capacity for short duration, when operated with condensate from ship's condenser and distilled water make-up. The heat release at this rating was 127,000 Btu per cu ft of furnace volume.

As these boilers were not adaptable for installation of new water walls and the boilers and furnaces as originally built would not be satisfactory for land operation with treated water, it was necessary to redesign and rebuild the furnaces by the installation of natural circulation air-cooled walls. The rated capacity of the reinstalled boilers is 50,000 lb per hr at a furnace heat release of 58,000 Btu per cu ft of furnace volume.

This extraordinarily high heat release could not be reduced by further increase in the volume of the new furnace, for this was limited by the circumferential dimensions of the existing boilers and by the undesirability of removing the radiant heat absorbing surface of the boiler too far from the furnace. To withstand this severe service, a sectionally supported, air-cooled wall with 60 per cent alumina firebrick was specified. The furnaces were built by Geo. P. Reintjes Co. Four different makes of refractory brick and tile were secured for furnaces, to determine from experience which make would prove most satisfactory for future repairs and replacements. To minimize the severe duty on the refractory air-cooled walls, about 15 per cent additional excess air is drawn into the furnace by natural draft through a series of ports, located in the lower part of the rear and side walls, for the purpose of lowering the furnace and refractory temperatures. See Figs. 4 and 4A on Page 68.

Since the concentration of solids in the boiler water will be several times that experienced on board ship, because of the high percentage of make-up, it was necessary to install steam baffles in the boiler drums to prevent excessive moisture carryover in the steam.

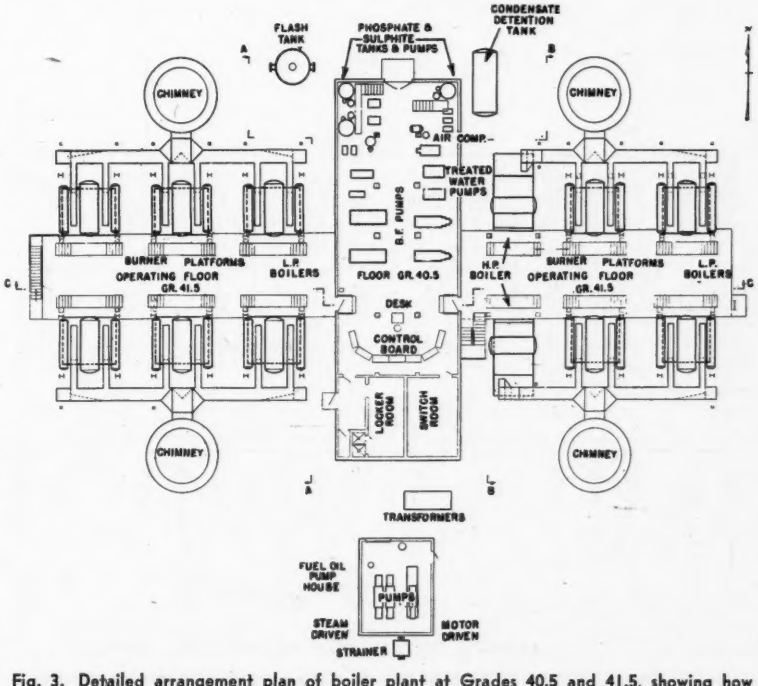


Fig. 3. Detailed arrangement plan of boiler plant at Grades 40.5 and 41.5, showing how boiler feed and other pumps, control room and laboratory are housed. Compare with Fig. 2

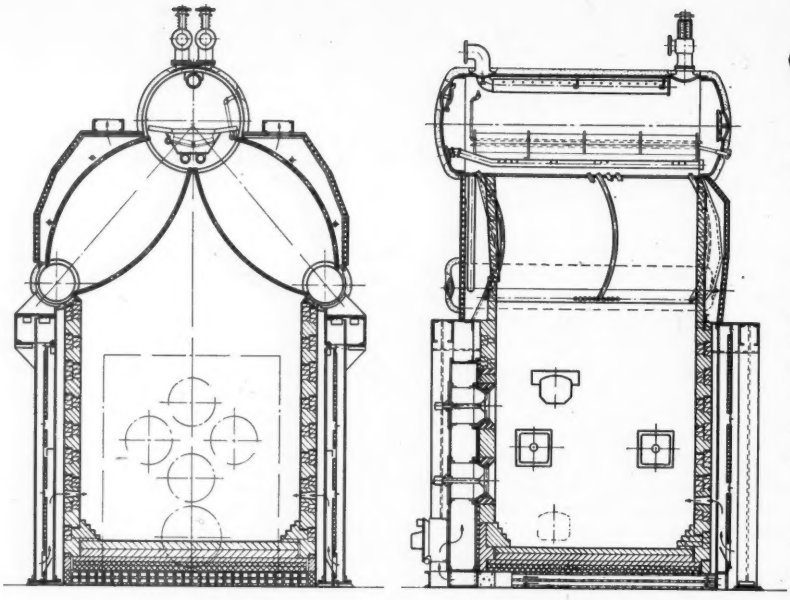


Fig. 4. Detailed cross-sections through one of the redesigned marine-type 200 psi boilers, showing air-cooled furnace walls, burners and blowers.

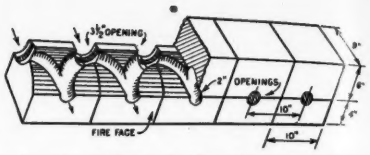


Fig. 4A. Details of sidewall tile for admitting air to furnace and reducing wall temperatures

Each boiler is equipped with four Babcock & Wilcox 19-in. diam combination gas and mechanical atomizing oil burners. Forced draft is provided by an individual turbine-driven Wing blower mounted on the burner wind box.

The general arrangement of the boiler and furnace as reinstalled is shown in Fig. 4.

High-Pressure Boilers

Two new Babcock & Wilcox integral-type boilers of 25,000 lb per hr capacity each, designed for 450 psi, generate high-pressure saturated steam for process work.

Each boiler is equipped with two Babcock & Wilcox 19-in. diam combination gas and steam-atomizing oil burners. Forced draft is provided by means of an indi-

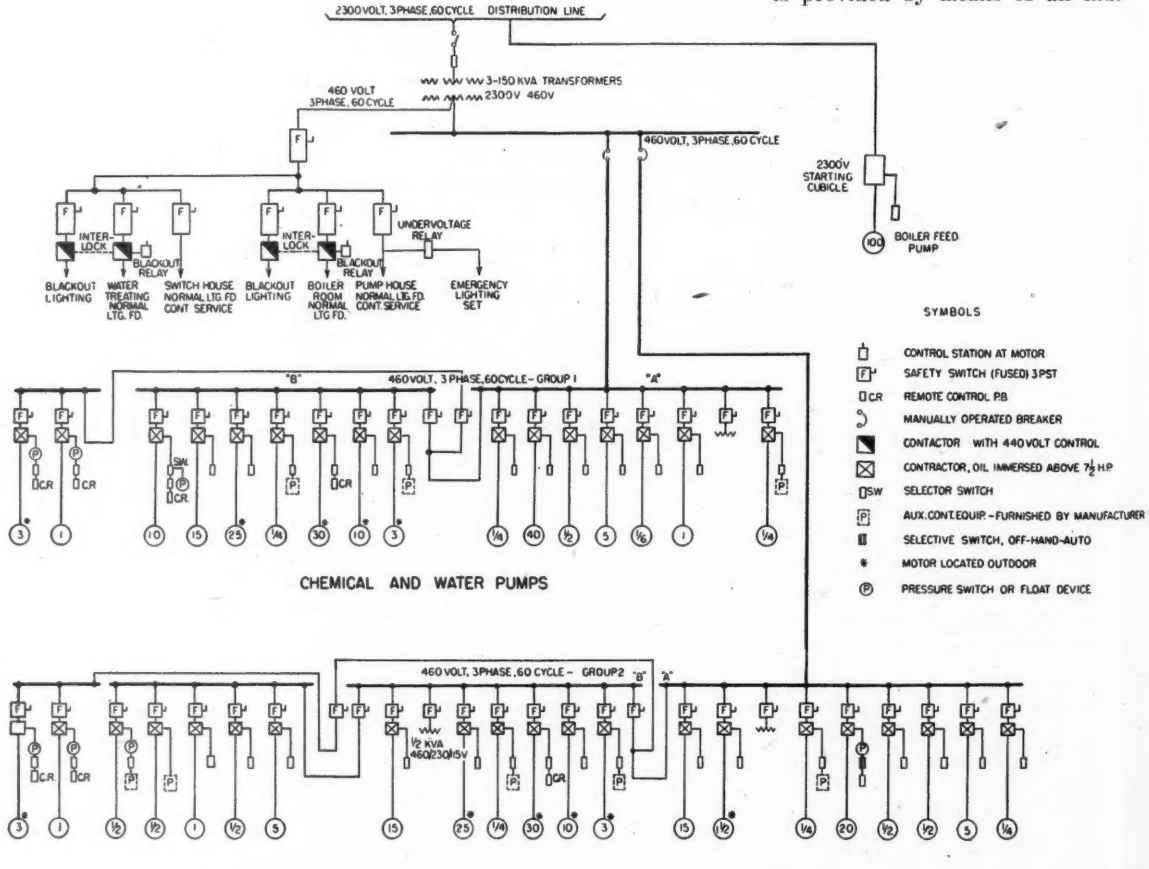


Fig. 5. Simplified electrical diagram of plant showing switching and protective equipment and connections of chemical and other auxiliary pump motors

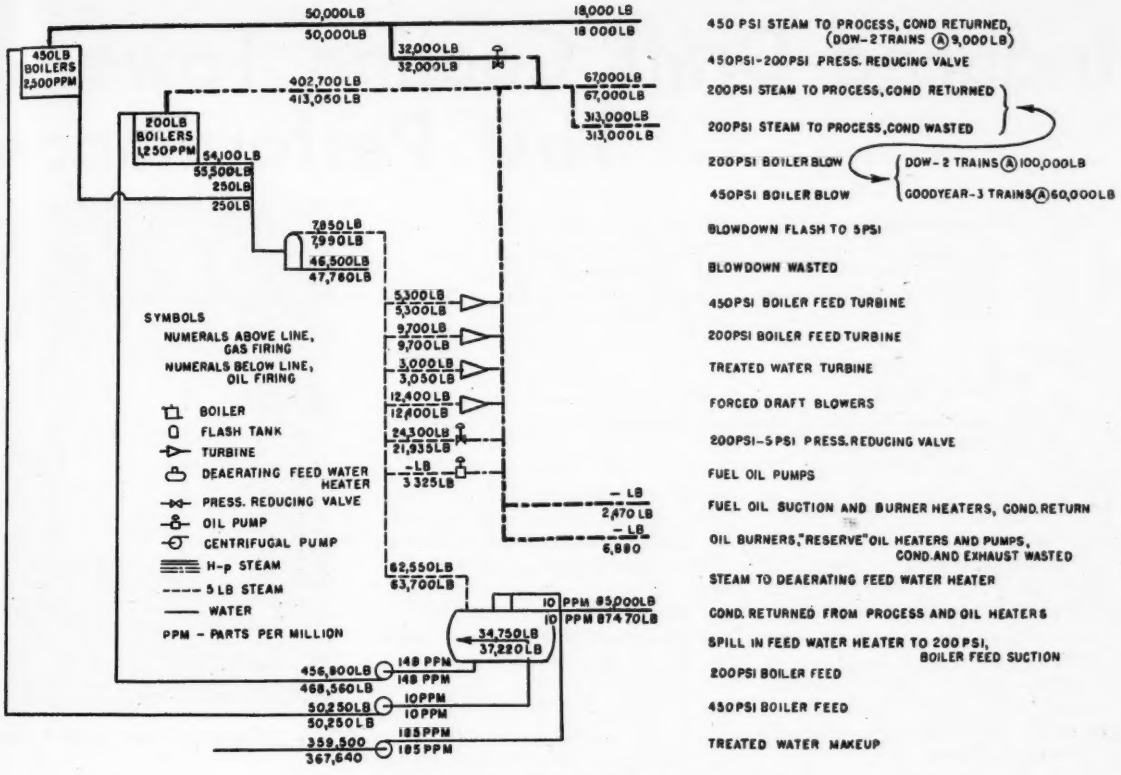


Fig. 6. Heat balance diagram of plant for normal load

vidual turbine-driven Wing blower mounted on the burner wind box.

The high-pressure steam main for these two boilers is connected to the low pressure main through a reducing valve, which permits both high-pressure boilers to be operated at full rating at all times, except when one boiler is down for repairs.

Boiler Arrangement

The boilers are arranged in two lines, each having five low-pressure and one high-pressure units, with the fronts of the boilers facing each other. Between the fronts of the boilers, a concrete platform 13 ft above grade serves as an operating floor for the water tender and as a roof over the fronts of the boilers. It also serves as a pipe gallery, which supports the main steam headers and from which the boiler feed, gas and oil piping headers are hung. The roof of the pump and control room is an integral part of this concrete platform and supports the deaerating heater, water tender's shelter house and outgoing process steam lines. This concrete floor with wood platforms around equipment and wood stairway is the only structure around the boilers. Figures 2 and 3 show general arrangement plan and section of the boiler plant.

Steel columns, girders and bracing are used for supporting the low-pressure boilers.

Boiler feed, treated water, priming, supplementary chemical feed pumps, emergency air compressor and automatic combustion control for the twelve boilers are located in a centralized control room, with six boilers on each side of this room. To the south of this room are the electrical switching and locker rooms.

Boiler Control

Automatic and remote manual combustion control for the twelve boilers is centralized on the control board in the operating room. All boilers on the line are group controlled from the master regulators for the five steam pressure systems. Fuel and air are controlled by steam pressure through a fuel-air ratio controller and stack dampers are controlled from furnace draft. Fuel-air ratio controllers for gas or oil and purge interlocks are located on four auxiliary boards installed in the firing aisle between the fronts of boilers. All combustion control was furnished by Bailey Meter Co. and is air actuated. Compressed air for the control system is normally taken from the styrene plant; however, if this source of air is not available, an emergency motor-driven compressor comes into service.

Copes feedwater regulators are installed on the low-pressure boilers and Bailey regulators on the high-pressure units. Hooded, illuminated, water-level gage glasses can be seen from the concrete platform at Grade 54.

Boiler Plant Pumps

To bring the boiler plant into operation from a cold start, a small low-pressure boiler feed pump is installed. Steam-driven boiler feed pumps for both high and low-pressure boilers are in normal service.

Two treated water pumps are installed, one turbine driven and the other motor driven, for supplying treated water to the deaerator, from which the boiler feed pumps take their suction. There is no difficulty in obtaining water from the treating plant from a cold start since all the pumps in this treating plant are motor driven. Boiler feed and treated water pumps were furnished by the Ingersoll-Rand Co.

A motor-driven Nash priming pump is located in the pump room and is connected to the treated water suction line. This was done

(*Continued on Page* 120)

Induced Draft Cooling Tower Test Performance

Tests conducted for the purpose of perfecting cooling system for condensing water indicated necessity of pipe changes. Diagnosis of system made. Test method described in detail. Results of tests tabulated. Analysis made of performance conditions

By E. S. Gray

Associate Professor of Mechanical Engineering
University of Missouri

BECAUSE of the difficulty in obtaining all necessary data with sufficient accuracy to warrant analysis, a complete test and heat balance of a forced or induced draft cooling tower is seldom made on location. Two complete tests, however, were recently completed on a tower at the power plant of the University of Missouri by senior mechanical engineering students.

The tower tested was a Marley single cell, 15 ft by 16 ft by 24 ft wood filled unit rated for 1090 gpm. The draft was induced by a 90 in. fan designed for a rated speed of 384 rpm driven by a 10-hp motor running at 1750 rpm. The tower serves a 300 kw General Electric turbine-generator and a C. H. Wheeler low-level jet condenser equipped with a steam-jet air ejector of the same make.

Purchase of the tower was made on the basis that the temperatures would be chosen so as to maintain 27.5 in. vacuum in the condenser. The turbine load or other conditions were not specified in the contract. The specified performance of the tower by the company, however, was that with a capacity of 1080 gpm, hot water at 103 F would be cooled to 89 F when the wet bulb temperature was 70 F with a drift loss of 0.2 of 1 per cent.

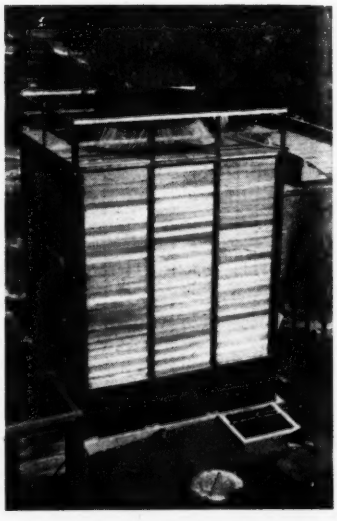


Fig. 1. Induced draft tower tested for performance

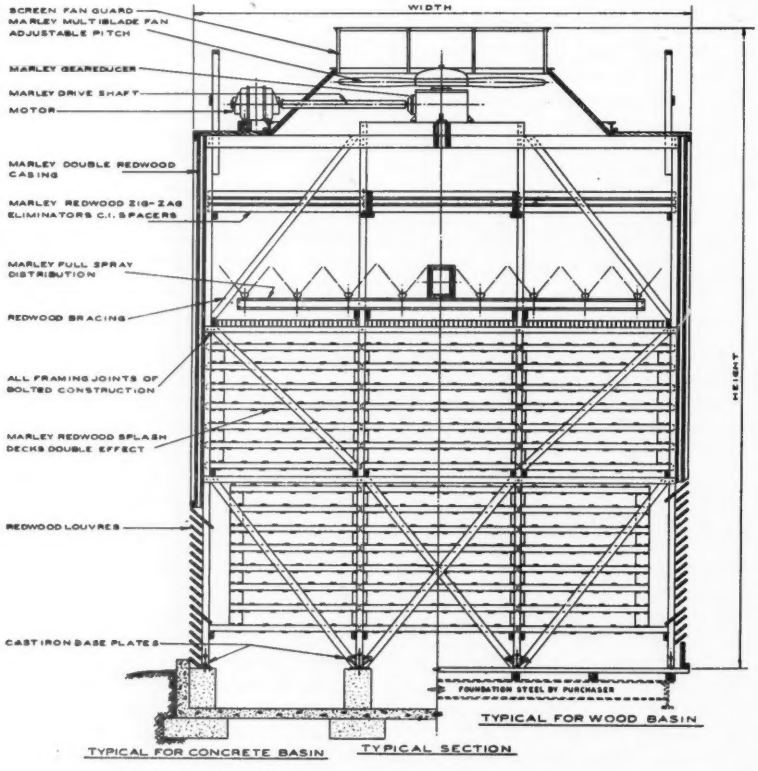


Fig. 2. Marley, filled type wood induced draft cooling tower

The occasion for the first test was a controversy arising from the failure of the tower to produce the required vacuum throughout the first season of operation except when first started or run with very light load. The test was made to ascertain facts and troubles in order that some settlement could be made. The second test was made after piping changes had been made to and from the tower and under a different set of outside air conditions. Incidental to acceptance tests but important for power plant information, was the heat balance of the tower and condenser made possible from test information obtained.

Cooling Tower Diagnosis

Before the tower was purchased cooling water was delivered to a home built atmospheric spray tower. The new tower was piped in parallel with the old, extension and piping being made on the job in the best way then possible without disrupting plant operations. The turbine-generator, condenser and air ejector were for various reasons all purchased second hand.

During the first test, the water gage pressure at the base of the tower furnished the first insight for the tower failure as installed. A pressure of 5.5 psi at 10 ft 10 in. below the nozzle header was all that was left of a 25.1 psi head pressure on the condenser pump. The additional head from gage to the spray nozzles and the friction through the pipe and nozzles left very little head available for water distribution and spray within the tower.

An inspection of the pipe lines between the condenser and tower gave the reason for the 19.6 psi pressure drop through the delivery system. The high pressure piping within the plant was all 6 in. with flange joints and fittings except a 5 in. check valve at the condenser. The nominal flange size for both high and low sides on the condenser pump was 4 in. The suction side piping was a combination of 4, 5, and 6 in. flanged. The extensions outside the plant beneath the ground were bell and spigot. There was one 5 in. globe valve on the return line at the condenser. To operate the unit under these conditions the globe valve had to be kept three-fourths closed to prevent taking all the water from the condenser. A 6 in. gate valve on the discharge side was kept wide open. Equivalent lengths of piping as found for conditions of the first test are summarized in Table I.

Table I. Equivalent pipe lengths as of TEST ONE

Line pressure at tower base.....	5.45 psi
Discharge pressure at condenser.....	25.10 psi
Equivalent Pipe Lengths, feet	
Return to Condenser:	
242 ft straight 6" pipe	
200 ft straight 4" pipe	
Discharge from Condenser:	
783 ft straight 6" pipe	
140 ft straight 5" pipe	

As a result of the first test and the findings thereafter the cooling tower company received settlement and the plan proceeded to rectify some of the piping faults. The piping to and from the condenser within the plant was largely replaced by 6 in. prefabricated pipe. Outside pipe was left as originally installed. The globe valve on the suction side at the condenser was replaced with a gate valve. The 4 in. flanged inlet and discharge from the condenser was not altered.

Following the pipe changes the second test was run. The condenser pump head pressure was reduced to 10.8 psi but the tower pressure remained practically the same, 5.3 psi. The friction and head drop was reduced to 5.5 psi. As a further result the operation of the condenser required that the valve positions be reversed, the high pressure valve being kept wide open and the lower side valve throttled to prevent flooding the condenser.

The curves of condenser vacuum against turbine load typical of plant performance before and after changes in piping were made are shown in Figs. 3 and 4 respectively. Neither log indicated satisfactory condenser performance. The second condition was definitely better than the first. Water pressure at the tower base was not materially improved.

Piping changes and test results indicated the probable adequacy of the tower to fulfill its guarantee provided the head and supply of water was suitable. The fault was proved to be with the condenser pump. The tower was designed for a capacity of 1080 gpm. In test one, from heat balance computations, it received 378 gpm and from the second test only 332 gpm.

The situation demonstrates several faults and practices common to many plants and to manufacturers of plant equipment. Because the pump did not deliver the required water at sufficient head showed that the pump characteristics did not fit the needs of the tower. The University plant had recently undergone needed expansion with limited funds. The tower purchase was made after the financial situation was less critical and was not predicted at the time of purchase of the turbine-generator-condenser unit.

The condenser pump characteristics were not made available to the plant management because of the source of the purchase. No attempt had been made to determine them from the manufacturer.

Testing

All data pertaining to the tests and balances were available except the cooling water flow rate to and from the condenser and the overflow or make-up of water to the plant because of evaporation from the tower in excess of or less than the steam flow to the condenser. The latter is applicable only to a jet condenser. The heat balance of the condenser and the tower provided this unknown data but without benefit of check.

Table II. Average Air Velocity Variations Through Louvres

Station	North Side Air Velocity Test 1	North Side Ft/Min Test 2	South Side Air Velocity Test 1	South Side Ft/Min Test 2
1	673.7	947.0	808.6	806.1
2	722.4	773.1	795.1	855.6
3	709.1	722.1	797.7	861.0
4	698.3	692.2	816.4	865.3
5	585.1	621.0	558.1	531.7
6	509.6	515.1	508.1	523.7
7	531.4	508.2	528.1	562.3
8	552.3	544.4	540.3	644.0
Aver.	622.7	665.4	669.1	706.2

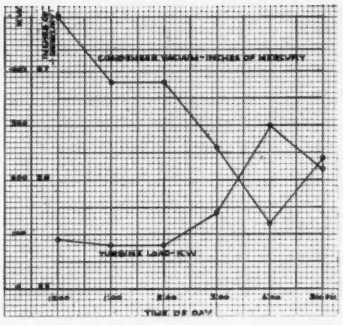


Fig. 3. Plotted log of unit No. 1 300 kw turbine generator, University of Missouri, October 28, 1940

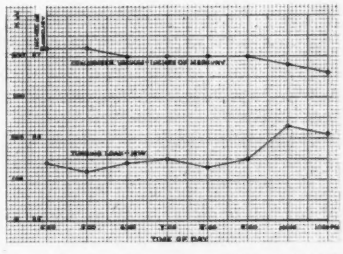


Fig. 4. Plotted log of unit No. 1 300 kw turbine generator, University of Missouri, December 24, 1940

Each test was of one hour duration, all readings being taken at ten minute intervals. The turbine load was read from the indicating meter at the turbine switchboard and the steam flow to the turbine from a Bailey meter using both recording and indicating values for checking. The integrated value was used for official calculations. Turbine exhaust pressure was obtained from a mercury manometer and the exhaust temperature from a mercury thermometer in an oil filled well in the turbine exhaust piping. Fortunately for the condenser heat balance, the steam exhaust was superheated.

The condenser pump head pressure was taken from a Bourdon gage on the turbine panel and corrected for center line distances. Condenser water temperature in and out were from mercury thermometers in oil filled wells within 2 ft of the condenser.

A heat balance of the condenser provided the only source of data for the cooling water flow rate to and from the condenser pump. In a conventional heat balance, radiation loss is often determined as the issue of the test.

In this case radiation had to be assumed as negligible. The assumption is not unreasonable for the low level jet condenser.

Critical cooling tower data required special attention to obtain true values. There were two 3 ft 10 in. by 15 ft intake louvres at the tower base on the north and south sides. These were extended outward one foot and each extended louvre then divided into eight equal areas by cords strung across the section as in Figs. 5 and 6. Anemometers, one for each side, were used to obtain air velocities. The instrument was held in the center of each area for one minute. A traverse of the entire section took about ten minutes and determined the frequency of data taking.

Two sling psychrometers were used for the intake air, one for each side. They were held in the center of each area following up the anemometer traverse. The magnitude of air velocity through the louvres justified the practice of holding the psychrometers stationary and vertical. This practice also allowed a more critical inspection of the minimum dip of the wet bulb thermometer, a point often overlooked in the use of this instrument.

Table III. Psychrometer Temperatures Above Fan Draft Tube

	Test 1		Test 2	
	Degrees F		Degrees F	
Location	D.B.	W.B.	D.B.	W.B.
North	94.6	94.6	80.8	82.0
East	91.8	91.0	79.8	79.9
South	94.7	94.3	81.2	82.3
West	92.1	91.0	79.5	79.5

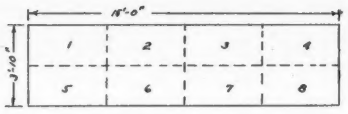


Fig. 5. Test locations on north and south sides of tower at base for entering air

It is accepted cooling tower practice to wet the wick of the wet bulb thermometer with water from the tower rather than with distilled water. This is based on the idea that the cooling water cannot be cooled to the wet bulb temperature of pure water as such is not being handled. The practice is undoubtedly justified. The effect on cooling tower calculations using standard psychrometric tables and charts is uncertain, but lacking corrected tables standard data are used.

To obtain leaving air conditions, a traverse of wet and dry bulb temperatures was made from four sides of the fan draft tube above the fan, as in Figs. 5 and 6, using a sling psychrometer held horizontal and stationary. On the second test the average wet bulb was higher than the dry bulb. This situation is not uncommon in cooling tower experience. Under high relative and absolute humidities of air intake, the air leaving the tower is likely to be very close to, if not for practical purposes, 100 per cent saturated. This was assumed to be the situation in test two for computing purposes.

Two explanations for the higher wet bulb are possible. The thermometers might have been in error. The blast of air and vapor with unevaporated water particles, however, make it impossible for the dry bulb thermometer to remain dry. The dry bulb then becomes a partial wet bulb from which some evaporation might occur. The wet bulb might have had some evaporation from its wick but because of the insulating quality of the wick, heat transfer was impaired with respect to the moistened dry bulb. The accuracy of wet bulb temperatures taken under similar conditions should be the subject of further investigation.

The hot water temperature to the tower was read from a mercury thermometer in a well just preceding the entrance to the

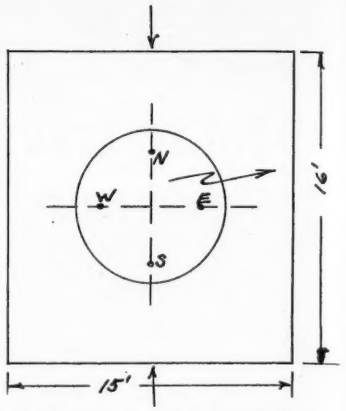


Fig. 6. Test locations above fan for psychrometric data on top of tower

Table IV. Average Cooling Tower Test Data

Item	Test 1	Test 2
1. Barometer, in. hg	29.10	29.03
2. Turbine steam flow, indicating, lb per hr	8,300.0	8,186.0
3. Turbine steam flow, integrating, lb per hr	8,150.0	8,150.0
4. Turbine throttle pressure, psig	157.6	158.6
5. Turbine exhaust pressure, in. hg vac	24.27	25.13
6. Turbine exhaust temperature, F	139.0	141.0
7. Turbine load, kw	250.4	246.1
8. Condenser pump, delivery pressure, psig	25.1	10.8
9. Cooling water temperature, in, F	89.0	78.5
10. Cooling water temperature, out, F	134.9	131.5
11. Tower water pressure, psig, (10'-10" below center line of nozzle header)	5.45	5.35
12. Tower water temperature, in, F	134.5	131.5
13. Tower water temperature, out, F	88.6	78.8
14. Dry bulb temperature, in, F	83.95	57.6
15. Wet bulb temperature, in, F	66.09	49.4
16. Dry bulb temperature, out, F	93.31	80.3
17. Wet bulb temperature, out, F	92.73	80.9
18. Air velocity, in, ft per min	645.9	685.8
19. Fan motor speed, rpm	1,767	1,736
20. Gear ratio, motor to fan	4.56 to 1	4.56 to 1
21. Motor current, amperes	27.3	27.8
22. Motor voltage, volts	223.5	222.6
23. Intake area of louvres, sq ft, each side	57.5	57.5

Table V. Cooling Tower Test Results

Item	Test 1	Test 2
1. Turbine steam flow, integrating, lb per hr	8,150	8,150
2. Turbine exhaust pressure, in. hg vac	24.27	25.13
3. Turbine exhaust pressure, psia	2.38	1.92
4. Steam temperature entering condenser, F	139.0	141.0
5. Degrees superheat, steam to condenser, F	6.7	16.6
6. Enthalpy of steam to condenser, Btu per lb.	1,122.0	1,122.2
7. Enthalpy of water from condenser, Btu per lb	102.8	99.4
8. Enthalpy of water to condenser, Btu per lb	57.0	46.5
9. Cooling water flow rate to condenser, lb per hr	181,700	157,800
10. Cooling water flow rate from condenser, lb per hr	189,850	165,950
11. Heat delivered by steam to condenser, Btu per hr	8,300,000*	8,340,000
12. Enthalpy of water to tower, Btu per lb	102.4	99.4
13. Enthalpy of water from tower, Btu per lb	55.6	46.8
14. Dry bulb temp entering tower, ave, F	84.0	57.6
15. Wet bulb temp entering tower, ave, F	66.1	49.4
16. Dry bulb temp leaving tower, ave, F	93.3	80.3
17. Wet bulb temp leaving tower, ave, F	92.7	80.9
18. Relative humidity, air entering tower, %	38.8	56.6
19. Relative humidity, air leaving tower, %	98.0	100.0
20. Total heat, air entering tower, Btu per lb dry air*	30.70	20.10
21. Total heat, air leaving tower, Btu per lb dry air*	58.5	43.62
22. Grains moisture, air entering tower, gr per lb dry air*	70.4	40.9
23. Grains moisture, air leaving tower, gr per lb dry air*	243.3	161.3
24. Grains moisture pick-up through tower, gr per lb dry air	172.9	120.4
25. Air velocity through louvres, total ave, ft per min	645.9	685.8
26. Sp vol, air entering louvres, cu ft per lb dry air*	14.32	13.55
27. Weight dry air entering tower, lb per hr	311,000	349,500
28. Weight vapor entering tower, lb per hr	3,122	2,040
29. Weight vapor leaving tower, lb per hr	10,800	8,050
30. Total evaporation, lb per hr	7,678	6,010
31. Per cent evaporation, %	4.05	3.62
32. Total heat pick-up, air through tower, Btu per hr	8,650,000	8,230,000
33. Total heat loss by water through tower, Btu per hr	9,320,000	9,120,000
34. Radiation and unaccounted for, Btu per hr	670,000	890,000
35. Radiation, per cent energy input, %	2.32	3.81
36. Water cooling, by evaporation, Btu per hr	7,678,000	6,000,000
37. Water cooling, by dry air pick-up, Btu per hr	695,000	1,905,000
38. Water cooling, by vapor pick-up, Btu per hr	12,200	20,000
39. Total water cooling effect minus rad, Btu per hr	8,374,000	7,925,400
40. Cooling effect by evaporation, % (incl rad)	84.8	68.0
41. Cooling effect by dry air pick-up, %	7.7	21.6
42. Cooling effect by vapor pick-up, %	0.14	0.23
43. Cooling effect by radiation, %	7.4	10.1
44. Overflow of excess water to sewer, lb per hr	472.0	2,140
45. Cooling tower efficiency, %	67.1	64.1

*Data from psychrometric chart corrected for barometer.

tower. Cool water temperature from the tower was taken from a submerged thermometer in the sump at the tower base.

Tower water pressure was determined from a Bourdon gage in the vertical delivery water line and 10 ft 10 in. below the distribution header and at ground reading level. Motor data for the fan drive were taken by a Starret counter, a voltmeter and a tong type ammeter.

The weight balance of steam to the turbine and evaporation in the tower was such that excess water was sent to the sewer from the tower base and was proved to be so by heat balance computations. This flow rate could not be determined by direct weighing. Its magnitude would have been helpful in checking the value as computed from psychrometric data.

Test data as outlined provided three points of balance and checks, two of which are independent. Neglecting condenser and pipe radiation losses, kinetic energy of flow, and pump work, the heat delivered by the exhaust steam to the condenser is equal to the heat picked up by the cooling water. The heat picked up by the cooling water in the condenser is delivered to the tower. The heat picked up by the air in the tower is received from the water plus or minus radiation from the tower.

The two tests were run under almost identical conditions regarding turbine load, steam flow and steam conditions. The second test showed 0.9 in. of mercury improvement in vacuum. The big difference in the test conditions was in the wet and dry bulb temperatures of the outdoor air. The first test was run on a warm day at 81.0 F with a wet bulb depression of 17.9 F. The second test was run when the dry bulb was 57.6 F and with a wet bulb depression of 8.2 F.

There was little drop in temperature of water between the condenser and tower. The saturation temperature of the steam at condenser pressure was 132.3 and 124.4 F for the two tests while the water leaving the condenser was 134.9 and 131.5 F respectively. Steam entering the condenser was slightly superheated in each case, with total temperatures of 139.0 and 141.0 F.

Only by a large number of values, frequently determined, of air velocity and temperatures such as explained above can an adequate tower balance be attempted. On field tests with small test staff such data cannot be determined because of the play of wind effects surrounding the tower. The test was adequately suited to the large group of engineering students.

The anemometer traverse across the intake louvres show interesting variations and indicate the large error which would have occurred if only one or two values of velocity on each side had been taken. Table II shows variations of air velocity across the louvres. Stations 1 to 4 are on top and show definitely higher

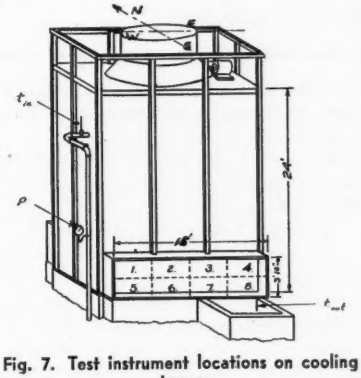


Fig. 7. Test instrument locations on cooling tower

velocities. Station 6 is low throughout.

The variations of wet and dry temperatures at four points around the fan over the draft tube were not drastic but nevertheless interesting to demonstrate the higher wet bulb temperature in test two. These are shown in Table III.

It has been demonstrated that under conditions of the first test the tower was not particularly efficient, 67.1 per cent which may be attributed to lack of enough cooling water and head delivered to it by the pump from the jet condenser. The water distribution and atomization was thus affected. Test results show a balance between the energy delivered by the steam to the condenser of 8,300,000 Btu per hr against 8,650,000 Btu per hr picked up by the air in passing through the tower and 9,320,000 Btu per hr left in the tower by the cooling water passing through it. The last two values being in excess of that delivered to the condenser by the steam indicated that, in spite of the best attempts to obtain accurate data, it is difficult to obtain a consistent and accurate heat balance. This is well known in the cooling tower business. In view of the data of Table II, the source of some error might be in the evaluation and determination of the weight of air entering the tower.

Heat lost by the water from evaporation, by dry air, and by vapor pick-up and not including radiation was 8,385,000 Btu per hr and compares more favorably with the condenser source. Had the indicating value of the steam flow meter to the turbine been used instead of the integrated, a closer approach to the balance could have been obtained.

The second test was run on a colder day when the relative humidity was higher and the outside wet bulb depression smaller than for the first test. The result is shown by the large increase in per cent dry air heat pick-up at the expense of the per cent of evaporative cooling. The radiation and unaccounted for loss increased to conform to the lower outside dry bulb temperature. This test was consistent in that the heat delivered by the exhaust steam was greater than that picked up by the air in the tower but it is still much less than the heat lost by the water to the tower. The tower efficiency was decreased to 64.1 per cent.

New Plating Is Superior to Nickel in Many Ways

CERTAIN COPPER or brass parts of aircraft instruments that carry high-frequency currents must be corrosion resistant.

Electrochemists have evolved an answer by providing special plating anodes made of an alloy of copper, tin, and zinc. With these soluble anodes, copper and brass parts are plated using standard plating practices.

The results are truly amazing, according to Westinghouse engineers. The plated surface has the necessary electrical conductivity for high-frequency applications and is far superior to nickel in corrosion resistance. Further, the finish is mirror-like, being surpassed in this respect only by silver itself. As to abrasion, the surface is roughly twice as good as the usual nickel coating. The new plating is entirely non-magnetic (not true for nickel) and is easily soldered, a fact of great value in many electrical applications.

Direct-Contact Heaters
on 5 Turbines at Buzzard Point Plant

Over a 10-year period, direct-contact heaters have been installed on each of 5 successive generating units at this famous plant . . . Operating experience with heaters on first unit in 1933 led to continuing improvements in control, booster pumps, heaters . . . Developments in equipment and methods are discussed in detail . . . Analysis of performance . . . Final results—very satisfactory . . . First article to give details of experience with this type of heater

By *H. H. Harrigan,* ***Plant Engineer***
and
H. G. Thielscher, ***Mechanical Engineer***
Potomac Electric Power Company

General Description

THE BUZZARD POINT PLANT of the Potomac Electric Power Co., Washington, D. C., has an installed capacity of 220,000 kw, consisting of two 35,000-kw, 625 psi, 825 F turbine generators and three 50,000-kw, 650 psi, 900 F units. The plant is designed to operate on the unit system with one pulverized-coal-fired boiler per turbine. Each of these turbines has three extraction heaters of the direct-contact type. The 35,000-kw units have a closed desuperheating heater in the discharge circuit of the boiler feed pump and the 50,000-kw units have four stages of extraction with a closed heater on the boiler feed pump discharge. Plans have been made for a fourth 50,000-kw unit with substantially the same heater arrangement. The heat balance diagram, Fig. 1, shows the arrangement of heaters and calculations for one of the 50,000-kw units.

Control System For First Unit

The original control system for the first unit* was designed to maintain a constant level in the boiler feed suction tank for all loads. This control consisted of a two-element air-operated control, one element operated from a float in the boiler feed suction tank, and the other from rate of flow in the suction line to the boiler feed pump. The impulses from these two elements were combined in a totalizer to actuate an air-operated valve in the condensate line to the first heater (14th stage).

It was found that, due to a lag of about three minutes from the time the load changed until the condensate reached the boiler feed suction tank, the system went through surges of, first, too much water being admitted, and then too little from the cold surge tank. In other words, the control system was overshooting or undershooting the requirements in its attempt to quickly restore a fixed level in the boiler feed suction tank.

Control System Now Employed

Figure 2 shows a diagram of the control system adopted as a result of continued experience and development. This system functions to permit a variable level in the boiler feed suction tank with load, carrying a low level at low load and a high level at high load. The total variation in level in the boiler feed suction tank is 12 in. This control of levels is accomplished by means of a two-element, air-operated controller, one element operating from the head of water in the boiler feed tank, the other from rate of flow measured in the discharge of the condenser hotwell pump. The impulses from these two elements are combined in a totalizer to actuate an air-operated valve in the condensate line to the first heater (14th stage).

On a pickup of turbine load, there will be an increase in the condensate flow but, due to swelling of the water in the boiler drum, the drawdown from the boiler feed tank will lag behind the rate of flow from the condenser. The net

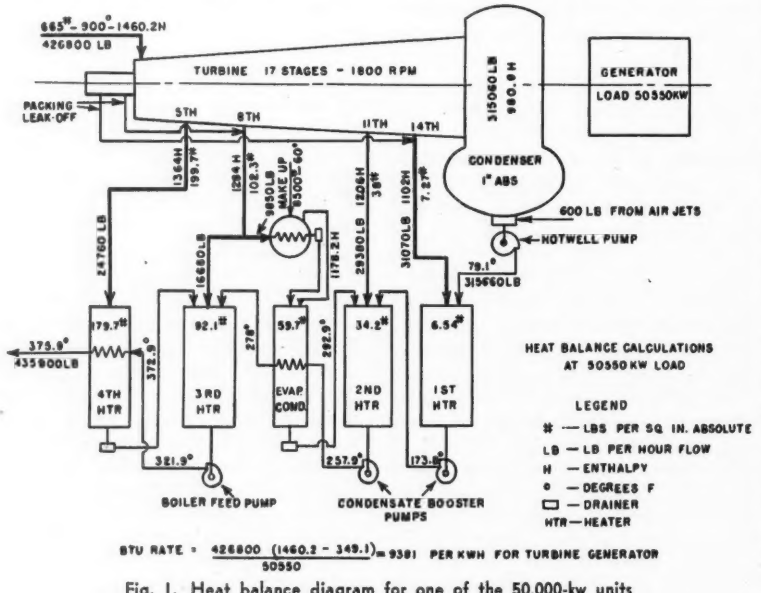


Fig. 1. Heat balance diagram for one of the 50,000-kw units at Buzzard Point, showing arrangement of heaters in the cycle

*Buzzard Point Plant Supplies Power to Capital, by H. G. Thielscher; POWER PLANT ENGINEERING, November, 1933, pp. 478-479.

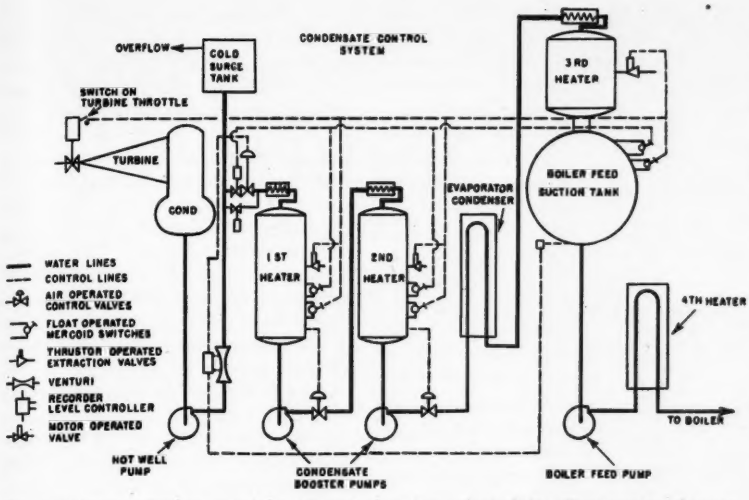


Fig. 2. Diagram showing principles of control system adopted for direct-contact heaters on all 5 Buzzard Point units as a result of continued experience and development

result is a compensated demand for admission of condensate to the system by way of the air-operated valve admitting water to the 14th stage heater. When the boiler feed pump discharge increases, the level controller in the boiler feed suction tank effects a further opening of the condensate admission valve until conditions become stabilized and the normal level is reached in the boiler feed tank for the particular load. The reverse happens on decreasing load with condensate discharged from the system to the cold surge tank. Recorder charts, Fig. 3, showing load, heater levels and boiler feed suction tank level, illustrate the functioning of this system.

Condensate Booster Pumps

As indicated on the diagram, Fig. 1, two condensate booster pumps are required to pump the water from the first extraction heater to the second and from the second to the third. These pumps are driven by constant-speed motors. The units supplied for the first turbine consisted of one motor driving two pumps in the same casing, separated from each other by a labyrinth sleeve.

Operation of this system disclosed the necessity for several changes in the original design to improve operating conditions. Pump impellers were specified for too much excess capacity; and this, coupled with lack of submergence, caused excessive impeller wear due to cavitation. Impeller capacities were reduced but, without any other changes, wear still existed. The pump casing, subjected to the unequal temperatures existing in the two pumps in a single casing, caused distortion of the casing and leaky joints.

To remedy these conditions the following changes were made:

1—A water storage section was added to the bottom of the first and second heaters.

2—Air-operated water level controls were connected to the water storage section, arranged to throttle an air-operated valve in the discharge of each pump, thereby maintaining a fairly constant water level in the heater and head of water on the pump suctions at all loads.

3—The single-case, two-section pump was superseded by two single pumps, coupled together and driven by one motor.

These changes have eliminated all the original defects and produced very satisfactory operating and maintenance results.

Details of Heaters

The direct-contact heaters, Fig. 4, are of Foster Wheeler Corp. design. The design is practically the same for all heaters except for changes required by pressure. Each heater is equipped with a vent condenser. The non-condensable vapors leaving these condensers are cascaded from the third heater to the second, then to the first and then to the main condenser, where these vapors are removed by the steam air jets. All vents are provided with orifices to limit the amount of venting.

As noted on Fig. 4, the steam enters the lower section of the heaters and the water at the top, overflowing a circular V-notch plate. The water then cascades through rain plates, condensing the steam. In the original design, severe hammering occurred in the first and second heaters with load changes. Opening the passages by enlarging the holes in rain plates and installing a vapor by-pass from above the first rain plate to a location above the V plate corrected

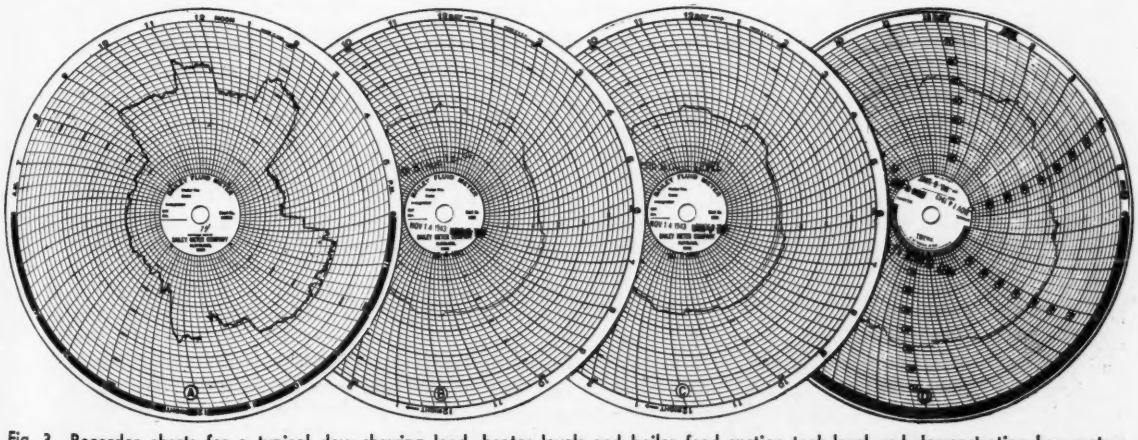


Fig. 3. Recorder charts for a typical day, showing load, heater levels and boiler feed suction tank level and demonstrating how system of Figs. 1 and 2 functions at Buzzard Point. A—Steam flow to turbine; B—Level in 2nd or 11th stage heater; C—Level in 1st or 14th stage heater; D—Level in boiler feed suction tank

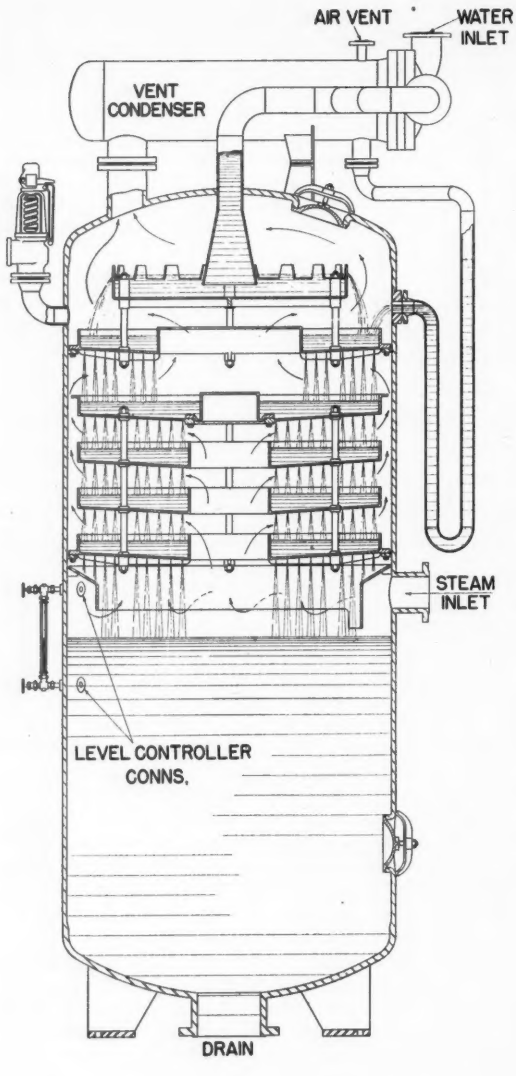


Fig. 4. Cross-section through one of the direct-contact heaters as installed at Buzzard Point. Design practically the same for all heaters, except for differences in details required by different pressures. Each heater is equipped with vent condenser. All vents provided with limiting orifices. Steam enters lower section; water enters at top, flowing over V-notch plate, cascading through rain plates and condensing the steam. Non-condensable vapors having vent condensers are cascaded from third to second to first heaters, then to main condenser, where they are removed by steam air jets. Each heater equipped with float-operated mercury switches to control extraction protection against reverse flow. The three heaters in series deaerate the feedwater and tests of oxygen content are given in the text

this. Clogging of holes in the rain plates can also aggravate this condition. Yearly inspection is made to clean out any holes found plugged. Hammering caused tray holding bolts to shake loose and damaged one pump impeller. Strainers were provided in the water outlet of the heaters and all nuts keyed to the bolts with cotter pins.

Flow of Makeup

In the original design, emergency makeup was admitted to the third heater to go directly to the boiler feed suction tank. This cold makeup admission caused severe hammering in the heater and was changed to the boiler feed suction tank, entering this tank at the bottom. Admission of makeup to the cold surge tank and to the boiler feed tank was controlled by floats in these tanks. The makeup supply came from distilled water pumps, which were automatically started from the water level in the tanks. The distilled water pumps had a capacity of 800 gpm to meet emergency needs of the boiler. One discharge line supplied both the cold surge tank and the boiler feed tank.

Under normal conditions, this capacity was not required. For normal makeup to the cold surge tank, a small pump (150 gpm) was installed, which floats continuously on the distilled water header. For emergency makeup to the boiler feed suction tank, a line was run from the distilled water header to the bottom of the tank, with a motor-operated valve at the tank. The float was removed from the tank. The large distilled water pump, and the motor-operated valve, are under push button control by the boiler operator.

Reverse Flow Protection

Protection against reverse flow of steam or water to the turbines is provided by check valves in the extraction steam lines. In heaters of this type, there is a large amount of water available to make flash steam in case of sudden load loss. It was necessary, therefore, to make certain that positive protection was provided. The extraction valves are of the swing check type, normally self-closing on reverse flow. But to insure closing, power operation comes into play if the valves should stick.

Each heater is equipped with two float-operated mercury switches, the floats being set at different elevations. The lower float will shut the extraction valve if water should rise, due to failure of a condensate booster pump, above the predetermined level in the bottom of the heater. The second float, at a higher elevation, shuts a motor-operated valve in the supply to the first heater, diverting all condensate to the cold surge tank. If the main turbine trips out, auxiliary switches operated by the throttle valve close all extraction valves.

In the original design, power operation of the extraction valves was obtained from pistons connected into the turbine high-pressure oil system. This design had two undesirable features: operation of the pistons upset governor oil pressure; and considerable small-sized pressure oil piping had to be run to locations where any leakage is undesirable. A design using motor-operated thrustors was incorporated in subsequent installations. These thrustors are mounted so that the application of power closes the check valve. When power is cut off, the thrustors are returned to their normal operating position by springs. This arrangement has proved to be very satisfactory.

Results of Operation of the System

The oldest set of heaters in this plant is 10 yr old. No appreciable corrosion of the steel plate has occurred. The worst point of attack is where vents and steam drips enter the heater shell. At these locations some pitting has taken place.

The three heaters in series serve to deaerate the feedwater. Typical readings of oxygen content are as follows:

Leaving Main Unit Condenser	0.05 cc per liter
Leaving First Heater	0.01 cc per liter
Leaving Third Heater	0 cc per liter

(*Continued on Page* 126)

Light Magic

To help plan better homes, hotels and public buildings of the post-war period a group of architects and designers were recently shown a number of the more recent developments in the field of illumination. This demonstration of laboratory models of new lamps and of possible post-war uses of new lamps and light was conducted by Samuel G. Hibben, director of applied lighting for the Westinghouse Lamp Division at the Waldorf-Astoria, in New York City. Several of the demonstrations are shown in the photograph on this page. Among the new lamps shown was the 10,000-watt mercury vapor lamp shown on page 64 of this issue. In some of the demonstrations lamps were lighted merely by placing them in the field surrounding a high-frequency generator. Such lighting of course would be commercially impractical at present but the demonstration was interesting

Fig. 1. (Above). In this demonstration Mr. Hibben holds a spherical globe in the field of a high-frequency generator. The globe is coated on the inside with phosphor like that used in fluorescent lamps. This phosphor becomes luminous under the action of the high frequency waves and so the globe glows in the holder's hands even though it is not visibly connected with a source of power

Fig. 2 (Above). Here is another demonstration in which a lamp is made to glow brightly without any mechanical connection to a source of electric power. This fluorescent lamp is energized by a beam of radio waves produced by a pre-war diathermy machine

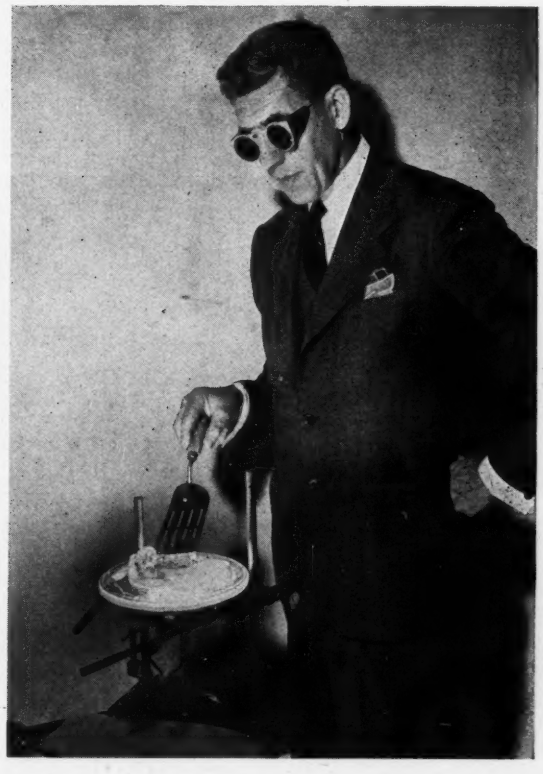


Fig. 3 (Right). Mr. Hibben fries bacon and eggs on the upturned lens of a sealed beam headlamp from an army bomber. Such units, properly re-designed might be used for the "comfort heating" of bathrooms in the post-war era

Steam for

One of the world's largest airplane engine factories requires two separate boiler plants . . . These can furnish total of 1,000,000 lb of steam an hour and 22,500 cfm of compressed air . . . One boiler plant contains two 225,000-lb-per-hr boilers fired by continuous-cleaning-type spreader stokers, removed from a utility plant; also two 110,000-lb-per-hr chain-grate-stoker-fired boilers and six air compressors. . . . Other plant contains three 110,000-lb-per-hr chain-grate-stoker-fired boilers and two air compressors. . . .

THE DODGE CHICAGO PLANT, Division of Chrysler Corp., is composed of such a large number of varied buildings distributed over such a big area that two separate and distinct boiler houses became a necessity. These are known as the Main Boiler House-Building No. 9 and the Forge Plant Boiler House-Building No. 14.

At the time of design, steel was considered a critical material, consequently a reinforced-concrete frame was used for the buildings, and wood was used for boiler walkways and for bridges to support outside, overhead pipe lines to the Forge and Foundry Buildings.

Forge Plant Boiler House

The Forge Plant Boiler House contains three Babcock & Wilcox four-drum Stirling boilers, each capable of producing 110,000 lb per hr of dry saturated steam at 175 psi gage pressure. These boilers are equipped with side water walls, water-cooled front walls and bridge walls, and are set in a suspended wall setting of M. H. Detrick Co. design. They are fired with Babcock & Wilcox chain grate stokers, have Babcock & Wilcox air preheaters and are equipped with Clarage Fan Company's forced and induced-draft fans, dual driven. Fan drive is either by Elliott turbines or General Electric motors. Both forced and induced draft fans are housed in an overhead enclosed fan room in the boiler house, with provision to take air for combustion from outside, from the boiler room or from both sources. Products of combustion are discharged to the atmosphere through short, gunite-lined stacks.

Combustion Control

Combustion control and instruments are Republic Flow Meters Co. make. Controls are pneumatically operated by compressed air taken either from the 100-psi compressed-air system through a reducing valve or from a separate motor-driven, compressor-receiver unit, to be operated when the main compressors are not running. Fuel feed is regulated by varying stoker speed through a Reeves Pulley Co. variable-speed drive. Furnace pressure is maintained constant by adjustment of dampers on the inlets to the induced-draft fans. Air flow is regulated by adjustment of inlet vane dampers on the forced-draft fans.

The combustion control panel has three 9-unit draft gages, three 2-pen recorders for recording steam flow and CO_2, three 3-pen recorders for recording air and flue gas temperatures, three steam flow integrators and the necessary combustion control instruments to permit manual as well as automatic control.

Reducing Stations for Forge Plant Steam

All steam, which is generated at 175 psi gage and which is to be used in the forging hammers, is reduced in the boiler house to 120 psi gage through two parallel reducing stations, one designed to handle one-third of the load and the other to handle two-thirds of the load. Keeping these reducing stations remote from the pulsating effect of the hammers tends to stabilize their operation and at the same time brings them within the immediate control of the operating engineer.

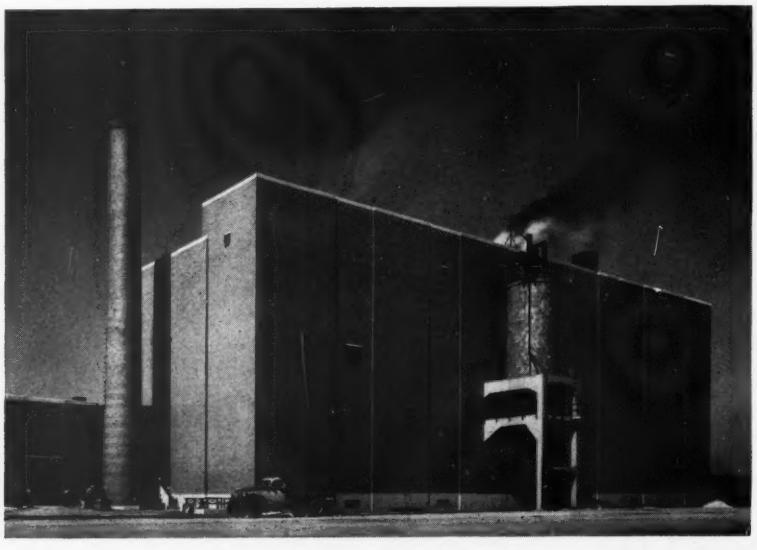


Fig. 1. View of main boiler house, Bldg. No. 9. The chimney is not part of boiler installation but serves incinerator, the low structure at the left

Feedwater Heating

Since summer operation of the forging hammers provides a large quantity of unusable exhaust steam, the Elliott deaerating feedwater heater was designed to handle practically 100 per cent make-up, composed of cooling water from two 1500-cfm Ingersoll-Rand air compressors located in the boiler house, and from cooling operations in the forging plants and heat treat buildings. The feedwater heater is supplied with 5-psi exhaust steam from the forging hammers or boiler house auxiliaries or both. Condensate and make-up water are stored in an overhead tank near the boiler house roof above the heater. Water from the heater is pumped to the boilers through three Dayton-Dowd, two-stage, centrifugal boiler feed pumps, one driven by a Crocker Wheeler motor and two by General Electric turbines.

The above mentioned compressors are driven by Electric Machinery Mfg. Co. synchronous motors and each machine has its own externally mounted air intake filter and discharge receiver as well as its own aftercooler in the compressor room.

Coal and Ash Handling

Coal is brought to the plant in cars on a spur track alongside the boiler house, dumped through a grating into a track hopper, carried by apron feeder to a bucket elevator whereby it is lifted to a belt

the Dodge Chicago Plant

conveyor running above an elevated bunker the full length of the boiler house. A traveling tripper distributes the coal throughout the bunker, from which it is taken by a suspended, traveling weigh larry and deposited in the several stoker hoppers. All coal handling equipment is by the Fairfield Engineering Co.

Ash, fly ash and stoker siftings are carried pneumatically by United Conveyor Company's "Nu-Veyor" equipment to an overhead ash storage tank located adjacent to the boiler house and spur track. Ash from the tank is discharged through a dustless unloader to trucks or railroad cars as required.

Main Boiler House—Building No. 9

The Main Boiler House contains two Babcock & Wilcox boilers, of 110,000 lb per hr capacity each, of the same design as those in the Forge Plant Boiler House, and two Babcock & Wilcox five drum W-type Stirling boilers of 225,000 lb per hr capacity each. The smaller boilers are fired with Babcock & Wilcox chain-grate stokers. The large W-type boilers are fired with Detroit Stoker Company's continuous cleaning type spreader stokers. Because of the proximity of the Main Boiler House to the main manufacturing buildings, all boilers are equipped with Buell Engineering Company's dust collectors for removal of fly ash from the flue gases.

Two Ex-Marysville Boilers Re-installed Here

The W-type boilers were originally installed in the Marysville, Mich., power generating plant of the Detroit Edison Co. They were dismantled, redesigned to suit the new stokers, newly equipped with water walls on all four sides and set in a new M. H. Detrick Co. suspended-wall setting. The superheaters and economizers with which these boilers were originally equipped were abandoned. Dry saturated steam at 175 psi gage pressure is generated in all four boilers. Space has been provided for a future 110,000-lb-per-hr unit.

Forced and induced draft fans for the 110,000-lb-per-hr units are of the same manufacture as used in the Forge Plant Boiler House. The arrangement, size and horsepower requirements of the induced draft fans for these units had to be changed from those supplied for the Forge Plant Boiler House because of the dust collector installation. Forced and induced draft fans for the 225,000-lb-per-hr units are American Blower Co. fans removed from the Marysville plant, reconditioned and remodeled to suit the new locations and firing conditions, and driven by new Electric Machinery Mfg. Co. synchronous motors, but not equipped with dual drive as are the smaller units.

Combustion control and instruments are of the same manufacture as in the Forge Plant Boiler House.

Fig. 2. General view of firing aisle, Forge Plant boiler house No. 2, Bldg. No. 14

Feedwater Heating

Since about 80 per cent of the steam from the Main Boiler House is returned in the form of condensate, the Elliott deaerating feedwater heater handles about twice as much water as the one in the small boiler house but only very little more 5-psi steam. Water from the heater is pumped to the boilers through five Dayton-Dowd, two-stage, centrifugal boiler feed pumps, two motor driven and three turbine driven.

Air Compressors Supply 19,500 cfm

The compressor room in the Main Boiler House contains six air compressors having a total capacity of 19,500 cfm of free air. Two of these are Ingersoll-Rand, 3650-cfm each, four-corner, two-stage, steam-driven compressors, taking steam at 175 psi gage and exhausting against 30 psi gage back pressure; two are two-stage, Ingersoll-Rand, 3500-cfm, motor-driven compressors and two are two-stage, Worthington Pump and Machinery Co.,

(*Continued on Page* 128)

Insulation-Lined Piping Permits Higher Temperature Steam

Development of a method of lining piping with specially selected insulation has made it possible to use carbon steel pipe for conveying extremely high temperature liquids and gases under pressure where formerly only alloy steel could be used. The principles involved and the details of installation suggest some fundamental changes in piping system design

MANY of the new processes for making synthetic rubber and 100-octane gasoline involve petroleum gases, superheated steam, and mixed vapors at temperatures ranging from 1000 F to 1500 F which are conducted under considerable pressure through pipes —some as large as 8 ft in diam and hundreds of feet in length. The vast amount of alloy steel necessary to handle these vapors in the conventional manner has presented a problem—alloy steel was high on the critical list. Pre-war sources of supply of vital alloys had either fallen into enemy hands or were seriously restricted by shipping problems. Demands for these materials for aircraft, ordnance and similar production was tremendous. It was definitely a limiting factor in the production of much-needed war material.

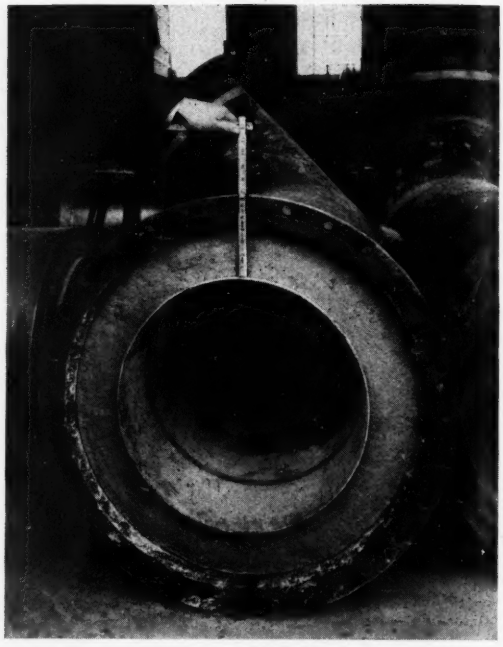


Fig. 1. Completed installation of cartridge type of insulation showing thickness of insulation material and metal lining

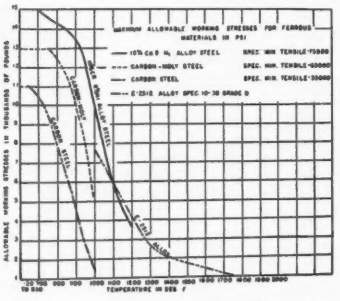


Fig. 2. Variation of allowable working stresses of various steels with temperature

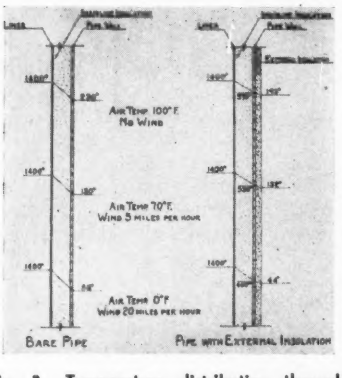


Fig. 3. Temperature distribution through Insidline construction

Faced with the high cost and sharply limited availability of alloy and inherent design difficulties in large high temperature piping, a large engineering construction company had begun in 1939 development of internally insulated piping, and had made an initial installation in 1940. From the experience gained in this and subsequent installations, this company was confident that carbon steel pipe of ordinary weight and construction could successfully handle the high temperatures involved in the new processes by incorporating a layer of insulation inside the pressure pipe to protect it from the internal temperatures.

The resulting internal insulation for pressure piping developed by Baldwin-Hill Co., called Insidline, accomplishes this purpose—not by the use of new materials, but rather by new combinations and arrangements of existing materials which make it possible to handle these high temperature gases and vapors, under pressure, through piping of comparatively light weight and low cost. This development made it possible to carry on the construction of synthetic rubber and high octane gasoline plants without drawing on the supply of critical alloys—thus enabling their use where alternates were neither available nor practical.

Construction Details

Insidline construction consists of a layer of high temperature insulating material placed against the inner surface of the pressure piping. The insulating material is a felted block with a diatomaceous earth base reinforced with amosite asbestos fibres. It is retained and protected by metal liners so arranged as to provide adequate expansion clearances with a minimum of heat flow through the metal. The inner liner is not required to resist pressure and is therefore not made pressure tight. It is only slightly stressed by its own weight, the impact of high velocity gases and the negligible weight of insu-

lating material. Its composition and thickness can be varied to meet conditions of temperature corrosion, erosion and velocity encountered in various installations.

The primary objective of the internal insulation and lining is to hold the temperature of the pressure piping to 650 F or below, where the phenomenon of "creep" does not occur and metals can be operated indefinitely at the usual stress allowances. (See curves in Fig. 2.) Thus, the use of carbon steel piping normally specified for a given pressure is made possible for a wide range of internal temperatures.

The secondary objective of the insulation is heat conservation, and this can be carried to any degree indicated by the economics or other considerations in a given process. The relative thicknesses of internal and external insulations are determined by the desired pipe wall temperature and rate of heat transmission. In practice, the internal thicknesses have varied from 1 in. to 4 in. and the external thicknesses from zero to 2 in.

Use of Insidline simplifies the design of pressure piping with considerable reduction in number of expansion joints, bends and other provisions for pipe expansion.

Two general classes of construction are used, dictated by the size of piping. Above 36 in. in diam, the entire construction is assembled within the pipe in the following order: Reinforcing rings and slip joint, insulating block, segmental liner (panels), through metal anchor buttons, and cover plates. The flexibility of modern arc welding is used to accomplish all assembly connections. Good welding technique results in smooth surfaces to minimize pressure drop and erosion.

Under 36 in. a cylinder or cartridge is rolled, welded and suitably reinforced. The insulation is applied to required thickness and retained by a thin carbon steel sheet which acts as a jacket to protect the insulation during installation. The complete cartridge is then inserted into the pipe and anchored by a cone connecting the inner liner to the pressure piping through welds. The next cartridge is then positioned to allow for expansion and is similarly anchored.

At elbows the insulation is a loose fill type and is tamped into place after the section of inner liner has been positioned.

In pipes too small to allow a man to work inside, the cartridges are joined and pulled into the pipe. Shop fabrication is normally employed, with the pipe shipped to the field ready for erection. With welded connections, a portion of the insulation and liner at the weld is installed after erection.

Expansion joints require special treatment, but can be adequately protected against high temperatures and heat loss. The entire method of construction is flexible and enables special fittings and shapes to be handled without difficulty.

Applications of this type of insulation have been made for flue gases, steam, petroleum gases, hydrogen and fluid catalysts for pressures up to 300 psi and temperatures up to 1500 F in various combinations. These conditions have necessitated installation in pipe sized from 2 in. up to 100 in. in diam and ranging from a length of a few inches up to single lengths of 60 ft on the straight. Velocities up to 500 fps have been used through Insidline.

Use of Insidline has permitted the development of extremely high temperature processes involving large sizes of pipe and equipment (see temperature distribution chart) without resorting to the use of excessive quantities of alloy steel, which would not have been available, or the use of which would have retarded other important Government war progress.

Fig. 4. Steel cover plate that is applied after insulation has been put down. The button in the center is welded to the outside pipe and later sealed with insulation and capped

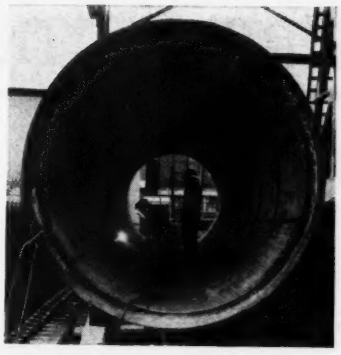


Fig. 5. Cover plates over panel type insulation being welded in position

Engineers Design Tiny Fluorescent Lamp

NO LARGER THAN A MARBLE, a new fluorescent lamp has been developed that operates with remarkable efficiency. It gives off more light than a quarter-watt neon glow lamp that consumes two and a half times as much power according to Westinghouse engineers. For the first time, modern fluorescent lamp efficiency has been obtained in a miniature-size light source. Thirty of these tiny bulbs take no more energy than an electric-clock. This economy adapts the new lamp to many military applications where very little energy is available. Using energy from dry batteries, it might be used to mark a cache of supplies to be left unattended for months. It could also be used as a flashing lamp on life rafts. If available after the war for household use, the lamp could burn constantly for six months (to mark a stairstep or keyhole) for about a penny's worth of electricity.

The lamp contains two spiral electrodes in a gaseous atmosphere. A discharge takes place when about 100 v a-c or 140 v d-c is applied across the electrodes. This creates an ultraviolet radiation that is retransformed (at high efficiency) into a green light—accomplished by the phosphor coating on the interior of the bulb. Other colors are possible but green phosphors convert "black light" to visible light most efficiently. A tiny resistor in the lamp base stabilizes current flow after discharge begins.

It is more than likely that lamps operating on this principle (in other colors and in slightly larger sizes) will be available following the war. They will be useful for marker purposes where low illumination with low energy consumption is desirable.

FIRST 10,000-KW MOBILE POWER

ONE of the Navy's newest possessions neither floats nor flies but, oddly enough, is destined to do its traveling over railroad tracks. The non-nautical unit is a 10,000-kw mobile power plant just delivered by the General Electric Co. to the Philadelphia Navy Yard for the Bureau of Yards & Docks, Navy Department.

First of its kind, the mobile plant is one of two such units G.E. is supplying to the Bureau. It comprises six specially built railway cars housing a complete steam-turbine generating station as well as the switchgear and transformer apparatus for controlling and distributing the 10,000 kw of electric power it is capable of producing. The mobile plant was conceived, initiated, and financed by the Bureau of Yards & Docks, and the detailed design was developed by General Electric under the supervision of the Bureau.

The unit has no motive power of its own, but it can be hauled over the rails by a locomotive at speeds up to 40 miles per hour. Thus it can be transported quickly to any point where additional or emergency power may be required by the Bureau's many domestic projects. G-E engineers have estimated that the unit can be put on the line within 24 hours after arrival at any operating point.

Bunker C fuel oil is used to fire the boilers, and a sufficient supply is carried in the mobile unit for two hours' operation so that power can be generated before tank cars are hauled up and connected.

Generation is at 13,800 v. The transformer included with the unit provides other voltages which correspond to those of the electric distribution system at any naval shore establishment where the unit may be needed.

All photographs shown are official U. S. Navy photos.

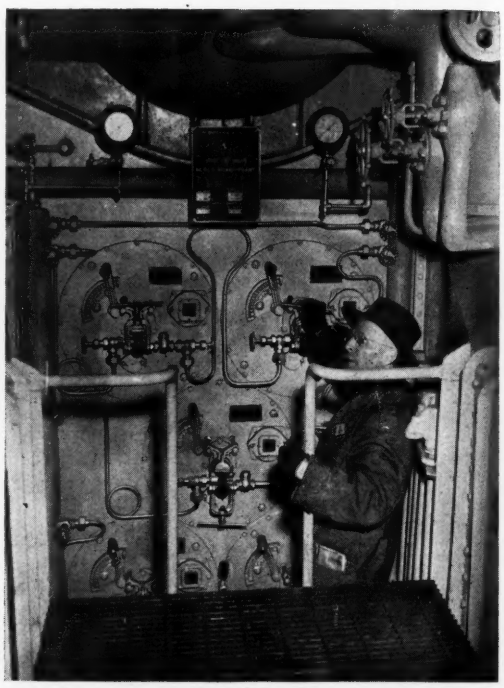


Fig. 1 (Above). Face of the oil-fed boiler aboard the mobile power plant. Its capacity output per hour is 140,000 lb of steam, which is piped to an adjoining car housing the main turbine generator. Built by General Electric and tested at the Company's Schenectady Works, the mobile unit was delivered to the Philadelphia Navy Yard where these pictures were made.

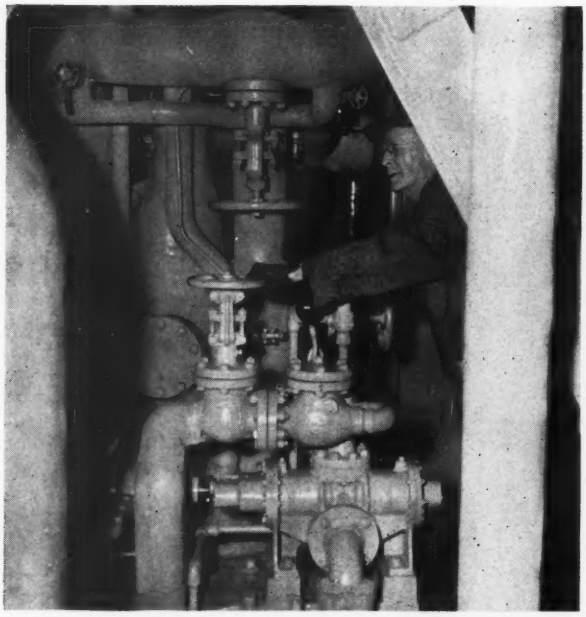


Fig. 2. Opposite the boiler face is this valve and pump assembly to feed water to the steam tubes of the boiler. Purpose of the mobile power plant is to provide a source of electric power which can be moved quickly to a Naval establishment in case of a power failure which cannot be remedied speedily by other means.

Fig. 3. The turbine-generator car contains an amazingly compact arrangement of steam power plant apparatus. In the upper center of this picture is an end of the turbine's condenser where spent steam becomes water. The two upright cylindrical objects in foreground are pumps to draw off the water. This car, heaviest of the six comprising the power plant, is carried on 10 axles.

PLANT DELIVERED TO NAVY

Fig. 4 (Above). Here are the principal units of the train, foremost the switchgear car, next the turbine-generator car, then the boiler car. Other units are the transformer car and two accessories cars carrying loose parts, such as the collapsible smoke stack, circulating water pump and piping, and auxiliary pumps for bringing in water and oil supplies. Combined length of the six specially built cars is 405 ft.

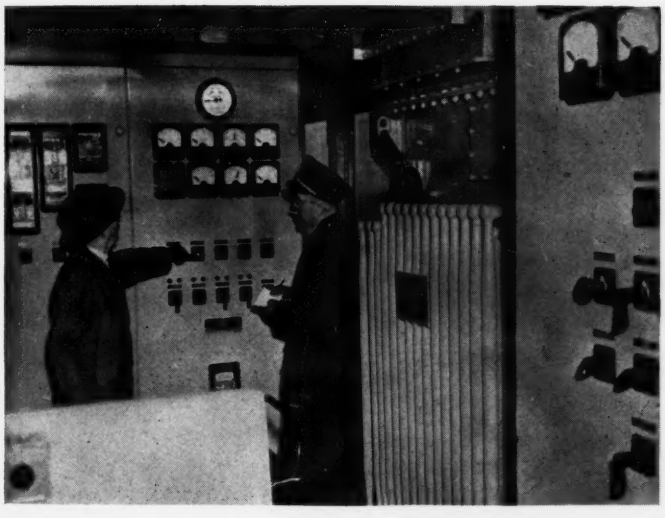


Fig. 5 (Left). Power is distributed through the switchgear car to the transformer in another car where the 13,800-v current from the generator is reduced to whatever voltage meets the requirements of the distribution system to which the train may be connected. The mobile unit needs only a supply of water and fuel oil to function and can be put into operation from a "cold" start within 24 hr, General Electric engineers say.

Fig. 6 (Right). A generating plant capable of producing sufficient electricity for a town of approximately 30,000 population and contained entirely aboard six specially built railroad cars is one of the Navy's newest possessions. This shows the "self starter" aboard the switchgear car of the amazingly compact plant. The Diesel engine at the right operates the small generator, left, which provides power to run oil pumps and other apparatus needed to put the main steam boiler and turbine generator into operation.

Pioneer Hydro Station Still Turning Out Kilowatthours

Plant built in 1896, believed to be the first alternating current hydroelectric development in Maine still in operation. It was one of the early projects of Stone & Webster and also one of the early users of the Scott transformer connection for phase transformation. Four 225 kw, 2-phase, 60-cycle, 1100-v generators, of the revolving armature type, are belt driven from a common line shaft

By C. E. Center ***Industrial Division, Westinghouse Electric & Mfg. Co.***

THE SMELT HILL HYDRO station of the S. D. Warren Co. of Cumberland Mills, Maine, was a pioneer in our electrical age and has several "firsts" and "near firsts" to its credit. The story of its construction offers many interesting sidelights on the subsequent developments in the electrical art and on the men associated with its beginnings.

Nearly fifty years in continuous operation, the station, originally called the Presumpscot Lower Falls Development, is believe to be the first alternating current hydro development in Maine. It feeds the first high tension transmission line in the New England area; although there were a few previous plants using 1100 and 2300 v, this plant transmitted at 8000 v, 3 phase, 60 cycles. It is also the first hydro development at tidewater, the effective head varying with the height of tidewater in the tailrace. One of the very early projects undertaken by the firm of Stone & Webster, Inc., it is also one of the early users of the Scott connection of transformers for phase transformation.

The S. D. Warren Co., one of the largest manufacturers of fine coated book and magazine papers, has its main plant at Cumberland Mills, a suburb of Portland. It is located on the Presumpscot River which drains the large Sebago Lake area and which flows into Casco Bay at Portland. The company was a pioneer in developing the water rights on the river due to the vision and interest of Samuel D. Warren, Jr., son of the mill founder. A hydro station on the river at Saccarappa was constructed for the company in 1889-1890 by the Massachusetts Electrical Engineering Co., Stone & Webster, managers. This was the year Edwin S. Webster and the late Charles A. Stone formed their partnership and this first contract launched their firm into a long and fruitful career in the engineering and construction field. The plant contained two dynamos and operated on a 500 v 3 wire d-c system with each dynamo connected between line and neutral. A d-c transmission line carried the power one mile to the mill and the load consisted of several 40 hp motors.

At the lower end of the river a natural gorge offered interesting possibilities for power generation. Accordingly, in 1889 a building was erected for this purpose in spite of the protests of various company officials who felt that it would be many years before the full capacity of the Saccarappa dyna-

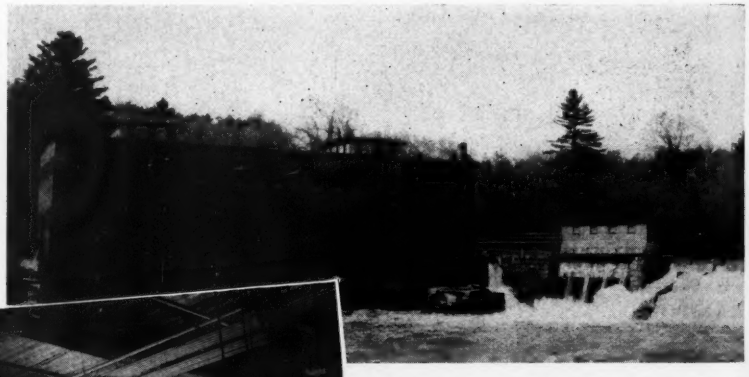


Fig. 1 (Right). Exterior view of Smelt Hill Station, Cumberland Mills, Maine

Fig. 2 (Below). Old Westinghouse generator in the Smelt Hill Station. Note the old doughnut type exciter at the extreme right

mos could be used. However, since Professor Carmichael's development of an electrolytic process for the production of chemicals used in paper manufacturing had proved successful in a small way, it was proposed to manufacture chlorine and caustic by this method. The process required much more electric power than was then available. Then too, the residential electric load of the town of Westbrook had grown and showed signs of further expansion; a growth which would be accelerated if certain franchises, sought after by other interests, could be obtained. Thus John E. Warren, mill agent, carried through the Presumpscot Lower Falls Development.

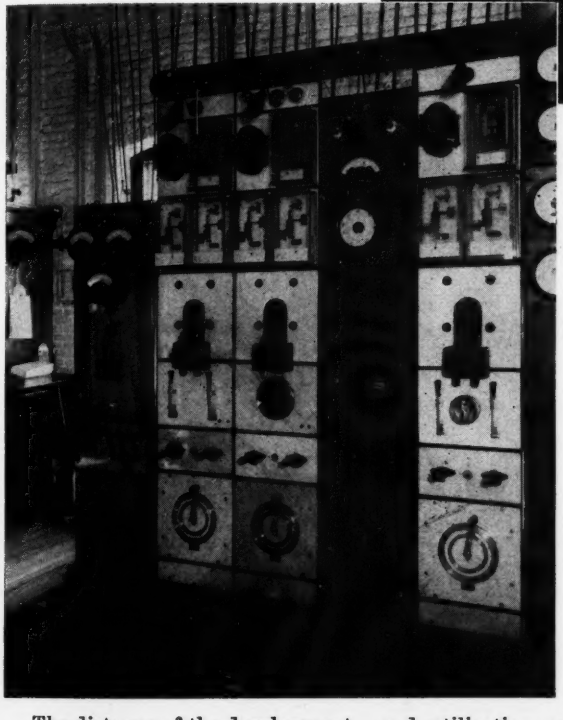


Fig. 3 (Left). Marble type switchboard with some of the original Westinghouse meters. Panel No. 3 was purchased by Henry Ford for his museum at Dearborn, Mich. The field control panel at the left was added in 1909

Fig. 4 (Above). Interior of the generator room at the Smelt Hill Station. This is believed to be the first a-c hydro plant in Maine

The distance of the development from the mills, nearly five miles, offered obstacles to the transmission of d-c current and the comparatively new system of alternating current generation and transmission was studied seriously and finally adopted. About that time there was a disastrous flood which washed away some of the d-c equipment and the time appeared opportune to change all of the mill equipment over to a-c, supply the electrolytic plant with rotary converters, and supply a-c to the residential load in Westbrook. The introduction of the Tesla polyphase induction motor by Westinghouse, and the greater flexibility of alternating current for transmission and utilization purposes were important factors in the decision. However, due to a combination of circumstances, it was not until 1895 that the first generator and two waterwheels were actually installed. A second generator and pair of wheels went into operation in the fall of 1896, and the remaining two generators and five wheels were installed in 1899.

The station building, measuring 146 ft long by 56 ft wide by 48 ft high, wheel pit to roof, was designed to contain ten vertical waterwheels; each wheel was rated 150 hp and was geared to a common horizontal lineshaft by means of wood cog mortise gears and pinions then in common use for industrial plant water-wheel drives. The renewable wooden teeth of the waterwheel bevel gears were of selected maple. Nine wheels were actually installed and these operate on a varying head, depending on the height of tidewater in the tailrace; this tailrace water changes from eight or nine feet minimum to about eighteen feet maximum. Four 48-in. diam Victor wheels were manufactured by Stillwell-Bearce, later the Platt Iron Works, and five Hercules wheels were manufactured by the Holyoke Machine Co., of Worcester, Mass. The wheels operated at 95 rpm driving the lineshaft at 160 rpm through 62/37 tooth gears and pinions.

Westinghouse supplied the four "Constant Potential Alternate Current" horizontal generators, each rated 225 kw, 301.5 hp, 2 phase 4 wire, 1100 v, 205 amps; they are belt driven at 450 rpm from the common lineshaft and the driving belts are 103 ft long with a center to center distance of about 42 ft between pulleys. The generators are of the revolving armature, compensating field type, and the copper brushes may be seen in Fig. 1. The names of men famous in the industry for their early contributions appear on the nameplates as patent holders: Stanley, for his fundamental work on transformers and generators; Schmid, for his developments in a-c rotating machines; and Shallenberger, known particularly for his invention of the induction type meter in 1888. These generators have been in practically continuous operation since their

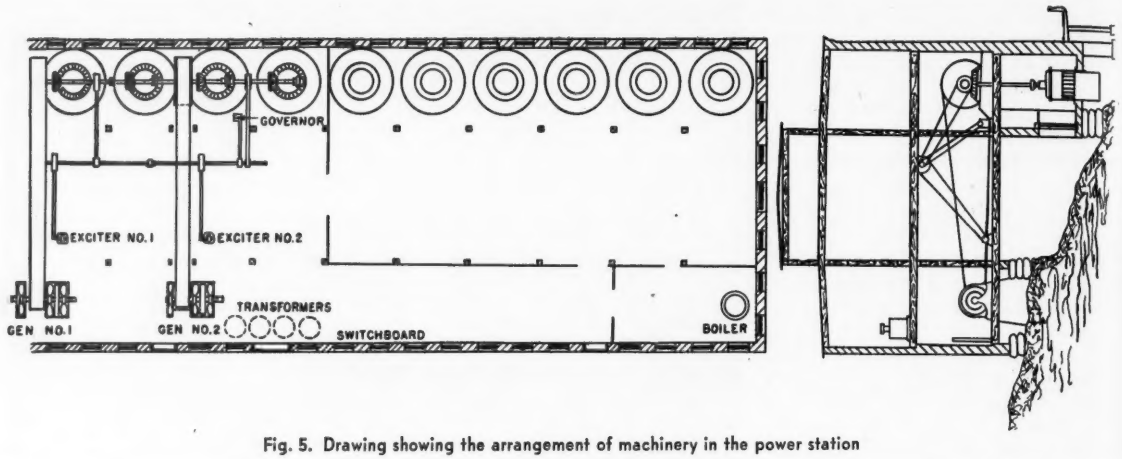


Fig. 5. Drawing showing the arrangement of machinery in the power station

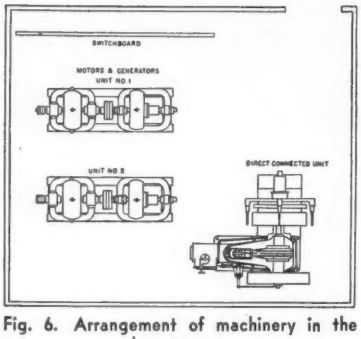


Fig. 6. Arrangement of machinery in the dynamo room

installation, although they have been rewound once or twice due to damage caused by external forces such as lightning surges. In fact, such surges at this plant led to some pioneer experimental work by Westinghouse engineers; as a result, much was learned concerning lightning behavior and protective equipment which was undoubtedly of enduring value to subsequent more pretentious installations.

Information taken from an original Stone & Webster blueprint of 1896 shows that the generator voltage of 1100, 2 phase, was transformed to 8000 v, 3 phase for transmission to the mill. The transmission line is 25,083 ft long and was protected by six sets of choke coils and lightning arresters on each phase. It is interesting to note that each phase contained one No. 1 wire and one No. 4 wire in multiple, and that there was a potential drop of 400 v in the line. The step-down Scott transformers were of 7600 to 440 v ratio and supplied power to a 2 phase 4 wire mill load consisting of four 50 hp and one 75 hp type B induction motor driving various lineshafts. Also supplied were two 100 hp type B induction motors driving d-c generators for the Carmichael electrolytic plant. When the station building was designed it was planned to install d-c arc lighting generators on the second floor. This of course was not followed out, the lighting load at the mill was supplied from the transmission line through a 100 kw single phase transformer with a secondary voltage of 1200 v.

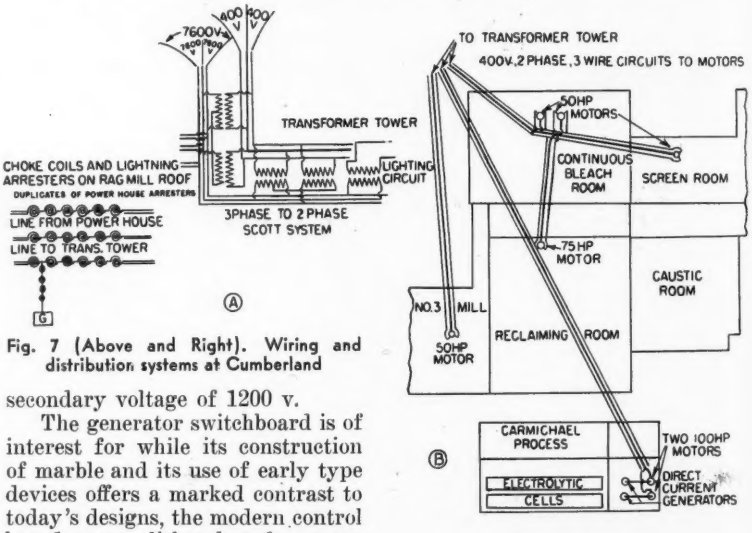


Fig. 7 (Above and Right). Wiring and distribution systems at Cumberland

The generator switchboard is of interest for while its construction of marble and its use of early type devices offers a marked contrast to today's designs, the modern control board accomplishes but few more actual results than this one. The four generator panels and an exciter panel are shown in Fig. 3. The black panel was inserted in 1927 to replace the original panel which is now, complete with original instruments, in the Henry Ford Museum at Dearborn, Michigan.

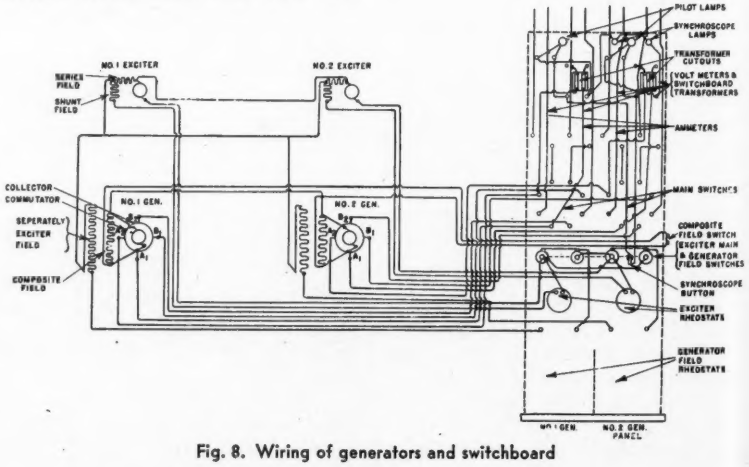


Fig. 8. Wiring of generators and switchboard

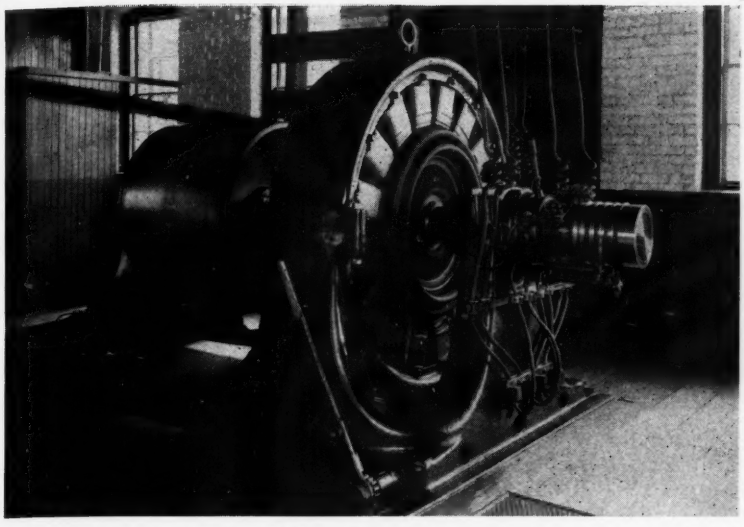


Fig. 9. One of the four 225 kw, 2-phase, 60-cycle, 1100-v generators operating at 450 rpm

The top sections contain the voltmeters and their 1100/110 v potential transformers; the voltmeters had no scale graduations, normal voltage being indicated by one line calibrated at the proper point. The next sections contain two ammeters, one per phase. Both voltmeters and ammeters are Westinghouse Type A, developed in 1888 which operate on the "attractive" principle; the electromagnet operates without iron, but when energized draws a soft iron plunger into the electromagnetic field. These meters utilize gravity return and originally had no damping devices. However, due to their erratic behavior on varying loads, the mill electrician added dampers of his own design. The ammeter scales are calibrated 0-150 amps. The type B oil circuit breakers, whose coverplates and handles are visible in the picture, are not original equipment, but were installed about 1905 to replace the original air break generator switches. These were of the plunger type consisting of four bayonet switches operated by a common handle.

This is believed to be the first installation where induction-type watt-meters, together with pilot current and potential transformers, were used. Fears were felt as to the results if, by chance, someone were to open the secondary circuit on one of the current transformers during full load conditions.

Original exciters were Westinghouse Type M, but some were later transferred to other service; one of the present standby exciters, visible in Fig. 2, is a Mather "doughnut type" transferred from one of the mill's early d-c installations. When erected, the station and transmission line were actually owned and operated by the Westbrook Electric Light & Power Co., associated with the Warren interests, which functioned until 1908. Ownership was then transferred to the Presumpscot Electric Co., a subsidiary of the S. D. Warren Co., which sold power to the mill. This subsidiary also constructed, owned, and operated subsequent hydro stations on the river; the capacity at Dundee was 3000 kw and at Eel Weir was 1800 kw. The combined output of the four hydro stations went to the mill and the towns of Westbrook and Gorham until the system was absorbed into the S. D. Warren Co. in 1925.

E. B. Newcomb, master mechanic, and W. B. Bragdon, "electrician" (later manager), employed by the Westbrook Electric Light & Power Co. together with P. P. Crafts, Stone & Webster engineer, were responsible for carrying on the construction of the Smelt Hill plant. Mr. Bragdon was active in the installation of all electrical equipment in the S. D. Warren plants until his retirement in 1931. At the present time the Smelt Hill Station supplies about 6 to 8 per cent of the total load of the S. D. Warren Co. and the 50 year old machines appear capable of many more years of useful service.

The writer wishes to acknowledge the help of the following individuals in assembling the data presented.

W. B. Bragdon, former gen. manager, Presumpscot Electric Co.

O. A. Fick, present electrical supt., S. D. Warren Co.

Edwin S. Webster, Chairman of the Board, Stone & Webster, Inc.

Henry G. Bradlee, vice-president, Stone & Webster, Inc.

L. B. Buchanan, Stone & Webster, Inc.

Electric Gage Measures to 0.0000012 Inch

ONE OF THE SECRETS of American industrial success is mass production. Mass production requires precision manufacture in all plants so that parts or machines are interchangeable. Precision tools are important but—according to Westinghouse engineers—behind it all stands that super-precise device, the master gage.

Recently designed devices of this type include the Electrigage by which accuracy of thread gages, threaded parts, machine-tool lead screws and racks can be checked. The instrument is graduated in fifty millionths of an inch and readings can be interpolated to about twelve millionths of an inch. This is equivalent to finding an error of three quarters of an inch in a mile.

Applied to an international measuring instrument with the same accuracy the device checks the outside or inside of a ring for taper, bell, or out-of-round conditions. Developed jointly by the Sheffield Corp. and Westinghouse, Electrigage uses a mechanical pick-up that has a feather touch of but three ounces. Movement of the gaging stylus alters a magnetic circuit to produce a current indication. Amplified as much as 10,000 times and fed to a specially sensitive milliammeter (with a linear scale and zero center) the pointer shows plus or minus error. Power is obtained from a 115-v, 60-cycle, single-phase circuit. An automatic stabilizer prevents voltage variation from affecting quality of the results. Exceptionally fast with good damping characteristics, the new instrument is of great value in production when readings must be obtained quickly.

POWER for a new powder plant in the South recently gave utility engineers a temporary headache. WPB wanted the load to be handled without purchase of any new major generating equipment. The problem was solved through installation of seven Westinghouse hood-type blowers which gave the station 25 per cent increased capacity, enough to supply the powder plant.

A 2520 kv-a capacitor rack with the front covers removed to show the interior arrangement

Power Factor Correction On A Large Scale

By W. K. BOICE

Industrial Engineering Department
General Electric Co.

THE LARGEST SINGLE installation of capacitors now in service is correcting power factor at a huge aluminum plant where the load consists largely of about 100,000-kw of mercury arc rectifiers for electrolytic production of aluminum. This load has a power factor of about 92 per cent.

In many plants, 92 per cent would be considered to be a very good power factor, scarcely calling for correction. However, what might be a small gain in a smaller plant becomes many thousands of dollars of operating expense for a load of this magnitude. Also, using a power factor nearer unity simplifies the problems of transmitting power over the long high-tension overhead lines feeding the plant. Not only are the line losses reduced, but there is less voltage drop at the receiving end of the line.

The following two means for power-factor correction at this plant were considered:

1. Synchronous condensers.
2. Capacitors.

The relative advantages and disadvantages of these two means has often been the subject of weighty discussions and extensive studies. However, in this case the use of capacitors carried one outstanding advantage—short shipment. While about 15 months is involved for completion of condensers, the capacitors required only 15 weeks. In these times, such an advantage is clearly understandable.

The capacitors for this installation comprise 22,680 kv-a of Pyranol* capacitors made up of nine 2520-kv-a equipments. An individual circuit breaker is not provided for each equipment, but breakers are provided for groups of equipments. Figure 1 is a typical one-line diagram of circuit breakers used to switch capacitors in three groups.

*Registered Trade Mark.

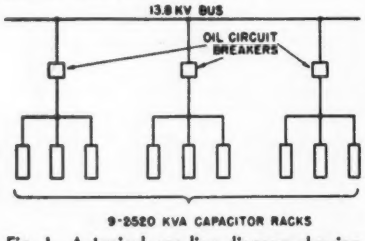
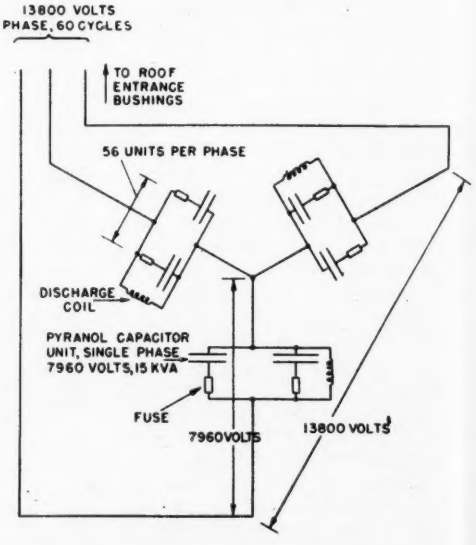


Fig. 1. A typical one line diagram showing circuit breakers used to switch capacitors in three groups

Fig. 2. Schematic connection diagram of a 2520 kv-a capacitor equipment nine of which are used in a 22,680 kv-a installation. Individual fuse protection eliminates the necessity for shutting down an entire equipment in the event of trouble in single capacitor



Each of the nine equipments consists of a large rack in a weather-proof steel housing, each rack containing 168 (15-kv-a) capacitors. The photograph at the top of page 88 shows one equipment with the side panels removed revealing the capacitors mounted inside. The housing is approximately 9 ft high, 21 ft long, and 5½ ft wide.

Figure 2 is a schematic diagram illustrating the internal connections of each equipment. It will be seen that individual fuse protection eliminates the necessity for shutting down an entire equipment in the event of trouble in a single capacitor. The Y connection with the "floating neutral" makes it necessary for current flowing in any one leg of the Y to pass through one or both of the other legs. Hence, the current to a short-circuit in a unit in any one leg is limited by capacitors in the other legs to such a low value that disturbance to the power supply system is minimized.

In parallel with the capacitor units in each phase is a discharge coil. This coil is a small reactor which draws a very small current when the equipment is operating at 60 cycles. When the equipment is disconnected from the line, the coils provide discharge paths for the capacitors so that a charge will not remain on the units and thus endanger the men who may work on the equipment.

Each housing is equipped with thermostatically controlled ventilating fans which operate only during peak ambient temperature conditions during a few days per year.

Large Dynamometers Use Amplidynes

By H. H. VERNON
Industrial Engineering Department
General Electric Co.

THE GENERAL ELECTRIC CO. recently built two cradle-type dynamometers which are the largest of this type in the world. These machines will be used for laboratory testing of airplane engines of approximatley 2000 hp, 3000 rpm. The design is complicated by the fact that they will be used with contraturning propeller drives involving hollow and solid shafts which extend from gear boxes on the engines and turn in opposite directions. Amplidynes play an important part in the control systems of these dynamometers.

Each complete dynamometer includes three units: one 2500-hp. 800/2000-rpm, hollow-shaft inductor unit; one 2000-hp, 800/2000-rpm, solid-shaft inductor unit; and one 800-hp, 800/2000-rpm, direct-current unit coupled to the solid-shaft inductor. The overall length of the set is 28 ft. Each dynamometer absorbs the engine output from 800 rpm up to 2000 rpm.

Referring to the sketch, it will be noted that the d-c uuit is connected electrically to the d-c unit of a synchronous motor generator set for adjustable-voltage (Ward Leonard) control to provide cranking and preliminary engine conditioning. During the test run 800 hp, less losses, is absorbed and returned to the power system through the synchronous MG set. This recovery of power helps to offset the cost of the d-c equipment.

The outer or hollow shaft (K) of the gear unit is connected to the hollow shaft of the 2500-hp unit (A). The inner shaft (L) of the gear unit is connected to the shaft of the 2000-hp unit (B). The floating shaft that connects unit (B) to the gear unit extends through the hollow shaft of unit (A). This arrangement allows the engine to rotate the rotors of the two units A and B in opposite directions but at the same speed.

The shaft of the 800-hp direct-current unit (C) is connected to the shaft of the 2000-hp inductor unit and the frames are connected together by torque frames. Each unit has its own bearings. The torque of unit A is indicated by one scale and torques of units B and C by another scale.

The inductor units are water cooled and the energy absorbed is carried away by the cooling water. The direct-current unit will be provided with forced ventilation.

Four amplidynes will be used in the control systems for the two inductors and for the two d-c units. One of the control MG sets carries an exciter for the synchronous motor. The following features, among others, are provided by the amplidyne control:

1. STARTING THE ENGINE—
When d-c unit (C) is starting the engine, the armature current is held constant at a preset value by amplidyne (4) acting on the field of d-c generator (G).

2. MAINTAINING CONSTANT TORQUE ON INDUCTORS (A) AND (B) WITH ENGINE IN OPERATION—
Amplidynes (1) and (2), by holding constant the excitation on inductors (A) and (B), maintain the torques of these two units constant.

(*Continued on page* 122)

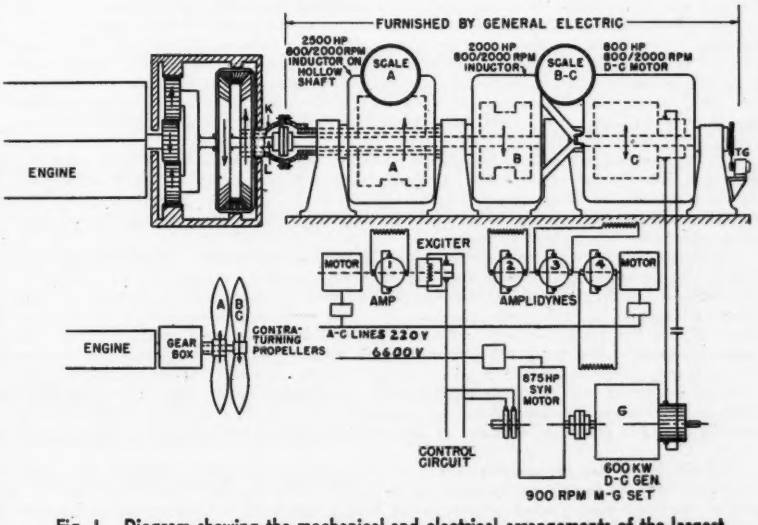


Fig. 1. Diagram showing the mechanical and electrical arrangements of the largest combination dynamometer in the world

The Gas Turbine— Part I*

An Engineering Dream for 150 Years

By

SANFORD A. MOSS, Ph.D.

Consulting Engineer, Supercharger Engineering Division, General Electric Co.

PRODUCTION of power by direct action of products of combustion on a turbine wheel has been an engineering dream for a century and a half. A number of approaches to the complete scheme now are in successful commercial operation, and it seems possible that these are paving the way for the long sought accomplishment of the primary plan of the gas turbine as an efficient prime mover. So it would now seem opportune to give some history and reminiscence (without any thermodynamics), list the partial accomplishments now in commercial use, and speculate on the future. The author can do this from personal association with many of the items ever since he became, in 1895, one of the many who have had dreams in the matter.

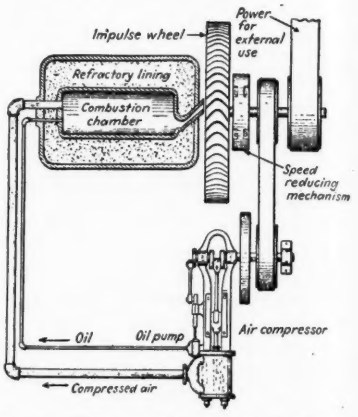


Fig. 1. Diagrammatic plan of fundamental gas turbine, patented by John Barber in Great Britain in 1791

"Will the gas turbine be the prime mover of the future? Will it displace our present steam plants, eliminating the steam turbine, steam generating unit and their auxiliaries? Will the gas turbine drive our automobiles, airplanes, ships, locomotives, as well as our factories? Will it——?"

Such questions are being fired at us daily by people who are just discovering this "new" development. Shucks! It isn't any more a new development than the "new" science of electronics (see Power Plant Engineering, December 1943, page 84). It isn't any more a new development than the "new" sciences of jet propulsion and rocket power, on which reputable scientists have been working for years (see Power Plant Engineering, April 1, 1930). It's just the good old "cultural lag" in operation.

Ever since about 1900, Dr. Sanford Moss of General Electric Co. has been carrying on research on the gas turbine. Yet the fundamental conception of the very type of gas turbine on which he and many others have worked since then was clearly outlined and patented in 1791—no, we don't mean 1891, we mean 1791. And there were gas turbines of a sort before that, consisting of bladed wheels installed in chimneys over open fireplaces and rotated by the hot combustion gases to turn roasting spits over the fire.

The turbosupercharger, which everybody knows all about today, is nothing but an application of the gas turbine. Developments in the latter led to use of the turbosupercharger for airplane engines in 1917—yes, 'way back in the warm-up war—and now, in turn, the things we have learned from the turbosupercharger make the gas turbine look much nearer as a prime mover.

But let Dr. Moss tell it in his own interesting and authoritative way, as he did in his paper on Gas Turbines and Turbosuperchargers before the Annual Meeting of the ASME on December 1, 1943, at New York City. In this paper he gives interesting data on how the gas turbine got where it is today. We are presenting an abstract of this paper in two parts, the first part in this issue, the second part to be published in a subsequent issue.

This information is interesting in itself. But even more important, it gives engineers the necessary background for estimating the future of the gas turbine. Engineers are the ones who are being asked about the potentialities of this development. They certainly should know some of the history of it, as they do of the steam turbine and the steam engine. Following Dr. Moss' paper, we plan to present some additional technical data on the gas turbine showing the basis on which other research workers are planning its development into the future.

For it doubtless will have a future and, as usual, that may be different from what the general public expects. Furthermore, as Dr. Moss points out and all the other authorities agree, many of the things now being learned about the behavior of metals in the gas turbine at temperatures of over 1000 F will be applicable in our present steam cycles. But these developments are delayed by the war.

As in the "new" science of electronics, the gas turbine enthusiasts caution us to keep our feet on the ground. They smile at the "breath-taking" predictions about the gas turbine in the Reader's Digest. They do not visualize it at present as an automobile engine, for compressor clearances in small compressors are about as much as in large ones, hence in sizes below 500 hp the gas turbine efficiency is very low. But they indicate possibilities that the gas turbine may well develop as a prime mover for locomotives, ship propulsion, for standby or emergency power generation or where water is scarce, or where compressed air or electricity are required and very little process heat. The present upper capacity limit of 5000-7500 hp fits these applications. Also, the research men are doing some work on gas turbines burning coal and coal-in-oil mixtures, in case our oil situation keeps on going from bad to worse.

But whichever way the development goes, engineers are the ones on whom the public must really depend for the gas turbine, not the feature article writers. Here then, right from one of the most distinguished workers in the field, is much of the interesting background against which all future ideas about the gas turbine must be evaluated.

Gas-Turbine Proposals

Beginning about 1890 both the steam turbine and the internal-combustion reciprocating engine began the competition which finally resulted in the elimination of the reciprocating steam engine as a prime mover, except for the steam locomotive, and present war emergency ship installations.

Ever since the beginning of this period it keeps occurring independently to students of thermodynamics that the steam turbine and internal-combustion engine might be combined, and so they "invent" the gas turbine. The usual form of this, shown in Fig. 1, has a chamber into which is forced compressed air and fuel, usually oil, so as to give combustion under pressure. The products pass through a nozzle so as to drive a turbine wheel, part of whose power drives the combustion-chamber compressor, and the remainder (if any) is the net power derived from the fuel burned.

The author was one of the many of these "inventors" while a student in the classes in thermodynamics and hydrodynamics of Prof. Frederick G. Hesse at the University of California in 1895. Like most of the other inventors, the author at first thought he was alone in the gas-turbine field. In 1900 an account was written as a Master's thesis and was filed in the University of California Li-

*First part of abstract of paper entitled Gas Turbines and Turbosuperchargers presented December 1, 1943, before Annual Meeting, ASME, New York City.

(*Continued on Page* 116)

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

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☆

If The Shoe Fits, Put It On!*

By Arthur L. Hodges, Maintenance Department The Reliance Electric & Engineering Co., Cleveland

I'm a 'LECTRICIAN—I AM!
I eat with Klein pliers, God Damn!
My necktie is wire
I light up the fire
With sparks from my own diaphragm!

The plumbing can all go to pot!
The carpenter work can all rot!
War or no war
I've already swore
I'll stick to my dear kilowatt!

The railing is off from the stair
The windows are nothing but air
The Navy is waiting
The motors need crating
But such things are not my affair!

We can't find our tools anymore
Our parts are spread out on the floor
But I can't get all sweaty
Such things are too petty.
(MacArthur's boys wallow in gore.)

I'm helping out my Uncle Sam.
(When the job suits me I am)
But if the job's dirty
My hands are too purty,
I'M A 'LECTRICIAN? I AM!!

*This was prompted by the disposition of some new men to avoid doing jobs, however necessary, for which they were not specially hired, yet which the war effort needed doing, and doing quickly.

☆

A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

THE ELECTRON TUBE—
Genie, Gremlin or Jeep?

By W. D. COCKRELL
Electronics Sect. Industrial Control Division
General Electric Company

THE AVERAGE industrial engineer, unfamiliar with electronics, who glances through almost any magazine today, technical or popular, is likely to be overawed by the promises of electronic things to come. It is quite likely that his first impression will be that the electron tube is nothing short of a genie straight out of the Arabian Nights—a superhuman spirit of fantastic complexity and far too elusive for the average mortal to comprehend.

Or he may take the opposite viewpoint. These odd looking electron tubes must fit into a class with the gremlins, mischievous little sprites, capable of much good, but more evil, and definitely to be shunned for as long a period as possible.

But on closer acquaintance, this electron "monster" loses most of its frightfulness, and turns out to be a friendly little jeep, rugged and reliable, capable of taking a terrific beating with minimum attention while doing a man-size job.

Like the jeep, the electron tube can do its job 100 per cent, but it cannot win the war unless the rest of the army pitches in to do its share. The rest of the "army" consists of the infantry of rheostats, transformers, and capacitors; the artillery of motors, generators, and amplidynes—all old friends, but perhaps not quite so quickly recognized under the accelerated tempo of this new mechanized warfare.

So let's all be good sports and not be too quick to condemn this electron "jeep" if the whole show does not come off as scheduled. Perhaps the break occurred at an entirely different part of the front. Did you ever shoot trouble for an hour and then find a blown fuse? That has happened on electronic panels, also!

What Are Electron Tubes Anyway?

Are tubes hard to understand? Anyone who understands the use of the simplest copper-oxide rectifier, the rheostat, and the direct-current voltmeter, can become a tube expert after one easy lesson—well, anyway, he'll know as much about an electron tube and how it functions in an industrial circuit, as many of us need to know.

In the first place, every true electron tube is a rectifier—composed of at least two elements or electrodes enclosed in an evacuated envelope made either of glass or of metal. One of the two principal elements of each tube is called a "cathode." The cathode is made of special materials, and is heated, usually by a small electric heater, to release electrons—those fundamental particles of negative electric current.

Here is an article on electronics for the practical engineer. It doesn't mess around with a lot of high powered theory or terms but gets right into the heart of the subject. In years past we have presented a great deal of fundamental information on electronics but at that time we were so far ahead of the procession, few took very much interest in what we had to say. Now, everybody and his brother is talking about electronics and you are not considered on the beam if you can't indulge in snappy repartee involving grid-plate transconductance, pentagrid converters, space charge factors, etc. Maybe you wonder sometimes why the boys leave you alone these days, why they look at you sadly and pitifully but let you eat your lunch alone. Do you know what is wrong with you? Of course you have thought it might be halitosis or B.O. but we can tell you, brother, it is something far worse; you are suffering from electronophobia—you are scared of electronics. That is why the girls on the swing shift pass you by; that is why you eat your lunch alone. . . . Well, it is a terrible affliction but cheer up—it can be easily cured. All you have to do is to sit down in your corner for a few minutes and read this article by Mr. Cockrell. Read the words, study the diagrams, and almost before you can say transconductance, the whole amazing world of electronics will be an open book to you. As Mr. Cockrell points out, you will be an expert on electron tubes and you will be able to talk about them with the boys —and the girls. . . . Don't be a dumb-bell any more, don't let the guys in the electrical department high hat you. A few minutes with Mr. Cockrell's article and you can tell them to walk a grid-plate characteristic or something equally sharp. It's all very simple and if you can understand the action of a non-return valve you can understand how a vacuum tube works. No kiddin', this is the opportunity of your life; don't muff it

Once, in the dim, dark past of high-school physics, we learned that anything charged positively attracts a negative charge. Then, in the next lesson, we learned that if the charge is negative, other negative charges are repelled. Thus, if we connect the other principal tube element, called the "anode," to a power source so that it is positive with respect to the cathode, the anode will attract the electrons from the cathode. But if conditions are reversed, and the cathode is positive and the anode negative, no electron flow will take place, because the anode is so made that it will prevent the loss of electrons. Thus, we get the one-way valve action of rectification; the electron flow (or the negative current flow, if you like to think of the normal current flowing from positive to negative) can move in but one direction through the tube — namely, from cathode to anode.

But that is not all. In these days of commando tactics, we are taught that it is most effective to kick a guy when he is off balance, or sock him when he is not looking. In a similar manner, if we can catch the current passing from cathode to anode in its simplest state, as a stream of electrons, we can control it with the greatest of ease. For instance, the electrons in an ampere-second of current weigh about a billionth of an ounce, something a lot easier to push around with a small control power than even the smallest and lightest switch or contactor. The control element added to the electron tube for this purpose is called a "grid," which is usually a spiral or grate of fine wires placed between the cathode and the anode. If the grid is held at a negative potential, with respect to the cathode, it tends to repel the electrons passing by it on their way to the anode, thus cutting down the flow of current, or possibly preventing it altogether. So long as the grid is negative, it pushes the negative electrons away, and thus collects no electrons to itself. No electrons means no current, and no current—even with a large impressed voltage—means no power. *And to be able to control current without the use of power is a neat job!*

Of course, if we make the grid positive, it will assist the flow of electrons to the anode and a larger current will flow, but only at the expense of some electron current to the grid. With the grid negative we can have control power for next to nothing.

Types of Tubes

The electron tubes that are used in industry may be divided roughly into three groups: phototubes, high-vacuum tubes, and gas-filled tubes.

Phototubes

A phototube is rather unique. It is a simple two-element rectifier in an evacuated glass bulb. The cathode is not heated to release the electrons, but is made of material which releases or "emits" electrons as light strikes it. These electrons can then be attracted

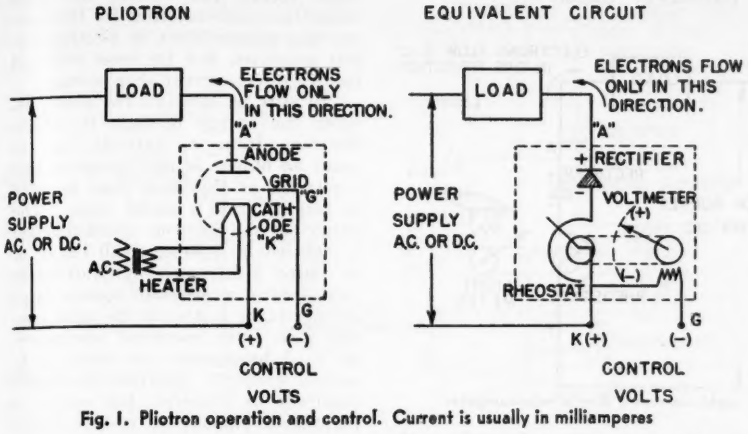


Fig. 1. Pliotron operation and control. Current is usually in milliamperes

as a small negative electric current to the positive anode. You might have guessed that the number of electrons which should be kicked out of the cathode material when light strikes a small cathode would not be very large; you would be quite right. We are lucky to get a millionth of an ampere, in most cases; and under certain conditions, the current is much less. In fact, the output is so small that in order to make use of it, we must boost it up or amplify it with a pliotron or thyratron, in order to operate even the smallest practical relay or motor.

Phototubes are the "electric eyes" of industry. Responding to a shadow or a flash of light, they may be used to count people, food, freshly painted articles, and other things which it is not desirable to touch, as well as to perform many other simple switching applications. In more advanced equipments, they can check or compare colors, read high temperatures, and control very rapid and accurate movements through the weightless and wearless light beams. The potential uses of the phototube are limited only by man's imagination.

High-Vacuum Tubes

Vacuum tubes which are simple rectifiers, and which have but two principal elements—the electron-emitting cathode and the collecting anode —are called kenotrons, or "diodes" ("di," indicating "two"). If we add one grid for the control of the electron stream, it becomes a "triode." All high-vacuum tubes with one or more grids are called pliotrons, or simply, amplifier tubes. Sometimes they are referred to by their function, such as transmitters, oscillators, or converters. If more grids are added in the electron stream to control the flow, as series valves in a pipe, the tubes may be called tetrodes (four-element, two-grid), pentodes (five-element, three-grid), etc. The typical vacuum tube is a low-current device which has a comparatively high voltage drop within the tube, yet it is capable of extremely fast and continuous control of the current with minimum grid power.

The pliotron is the familiar tube in radio receiving sets. Its role of amplifying a small signal or supplying a small output power is just as useful in industrial devices. Because of its characteristics of continuous control at extremely high frequencies, in the larger sizes it is used to supply the many kilowatts of power required for large broadcasting stations, or for induction and dielectric heating.

Gas-Filled Tubes

Gas-filled tubes, if used as rectifiers only, are called phanotrons; if they contain control elements, they are called thyratrons or ignitrons.

A thyratron tube has a hot cathode to emit the necessary electrons, and a grid to prevent current flow, when desired. However, it also contains mercury vapor, obtained from a drop or two of mercury in the tube, or it may contain inert gas, such as argon or xenon at low pressure. The gas or vapor helps to cut down the high internal voltage drop found in the pliotron. A constant voltage drop of about 15 v is held for any value of current within the ability of the cathode to supply electrons. (This is done by a process called ionization.)

Because of this low drop, a thyratron of a particular size can be rated for a continuous current of 10 to 20 times that of a pliotron of the same physical size. Thyratron current ratings run into amperes; most of the pliotrons with which we deal will carry continuously only a few milliamperes.

But gas filling does have a few drawbacks. For instance, the maximum voltage of the controlled circuit

"Aren't they just too adorable? He gave them to me for my birthday."

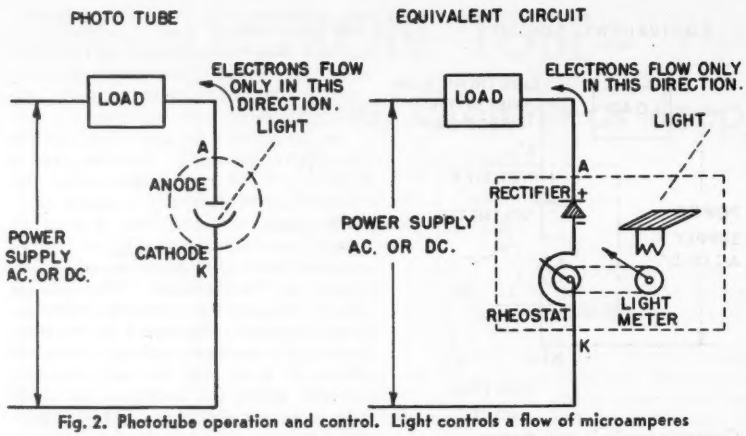


Fig. 2. Phototube operation and control. Light controls a flow of microamperes

is limited, but it is still well above the usual industrial control voltage range. Of more importance to us is the fact that the gas prevents the grid from controlling the current after the flow has once begun. In other words, a negative grid will prevent the flow of current as the anode is made positive; but once it has permitted the electron arc to start, it is powerless to stop it. The current can then stop only as the anode power is removed, or, in any a-c circuit, during the a-c voltage negative cycle. Even then, the deionization time required to regain control may be approximately a millisecond, therefore, thyratrons do not operate at frequencies much greater than the commercial power frequencies.

The thyratron is the handy-man of the industrial tubes. It controls motors, energizes magnetic contactors, and supplies small amounts of heat whenever accurate control or high-speed operations are required. Operating indirectly, by controlling generator fields or saturable reactors, it can control large amounts of power—many hundred horsepower or many kilowatts—for heat or lighting.

Ignitrons

The ignitron tube is similar to the thyratron in that it is a gas-filled tube, but it differs in that its cathode is not heated to free the electrons. Instead, its cathode is a pool of mercury and its electron-emitting energy is derived from the arc stream itself. This is a cumulative action—the larger the current the more electrons are made available. Thus, the instantaneous current capacity of the ignitron is limited only by the size of the elements and the leads to carry the heavy current. This may be thousands of amperes. The continuous current rating is determined by the ability of the tube to dissipate the heat losses. The larger sizes of ignitrons have built-in water jackets through which cooling water is circulated.

Since the ignitron, unlike the thyratron, does not have electrons immediately available at a hot cathode, its control element, the "igniter" — a pointed piece of crystal dipping into the mercury pool — must actually "blast" a few electrons loose from the mercury to start the arc stream. This requires real power; as much as 40 amperes at 200 volts, for a few microseconds. So it can be seen why the ignitron is most practical for high currents and large power requirements.

Ignitrons are the heavy artillery of the industrial tubes. They are called upon to control the thousands of amperes required for resistance welding. They rectify and control the large amounts of power needed for the manufacture of aluminum, in electrochemical processes, and for steel mill and factory direct-current shop voltage.

To SUM UP BRIEFLY: The phototube, using the energy of light to release electrons from its cathode, has so small an output in microamperes that a pliotron or thyratron must be used to amplify it to a useful value. The output of the pliotron (milliamperes) is sufficient to operate small relays, or to control a thyratron. Thyratrons, in turn, control amperes to operate large contactors, or motors in the usual control sizes from fractional horsepower up to 5 horsepower or more, or to control ignitrons. Ignitrons can handle hundreds of amperes, but require a reasonable amount of control power for operation.

How the Tubes Work

We said before that anyone who can understand a rectifier, a rheostat, and a voltmeter can understand tubes. Now we will prove it!

Take any kind of rectifier—copper-oxide or selenium—anything that will pass current in one direction and stop it in the other. Connect a rheostat in series and drive it by a voltmeter ele-

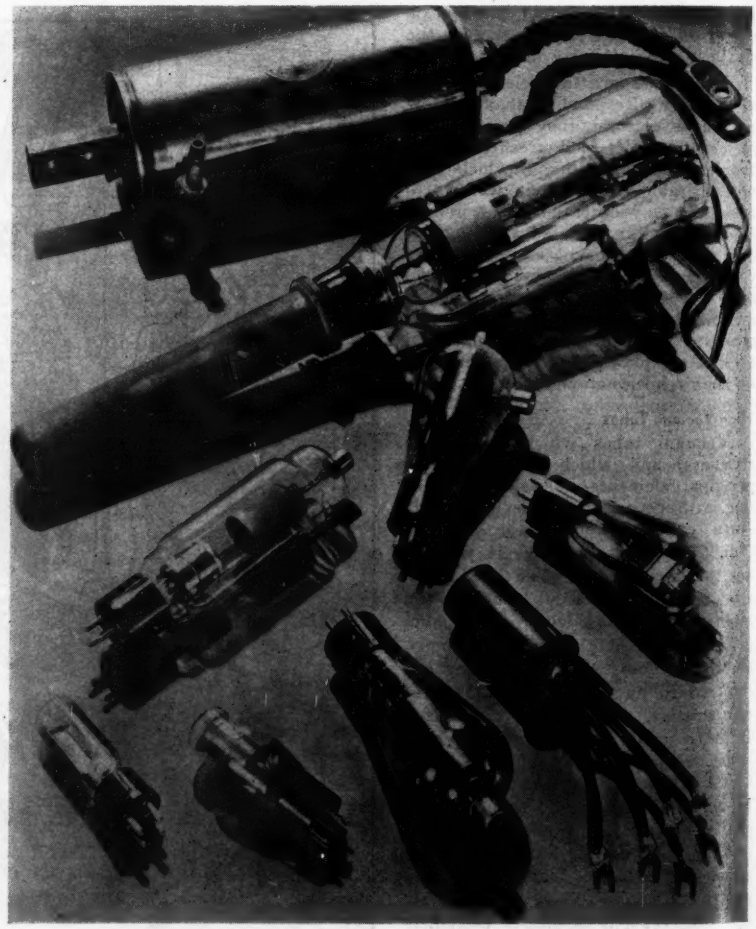


Fig. 2A. Tubes used in industrial electronics equipments. Included are the ignitron, pliotron, kenotron, thyratron, phanotron and phototube

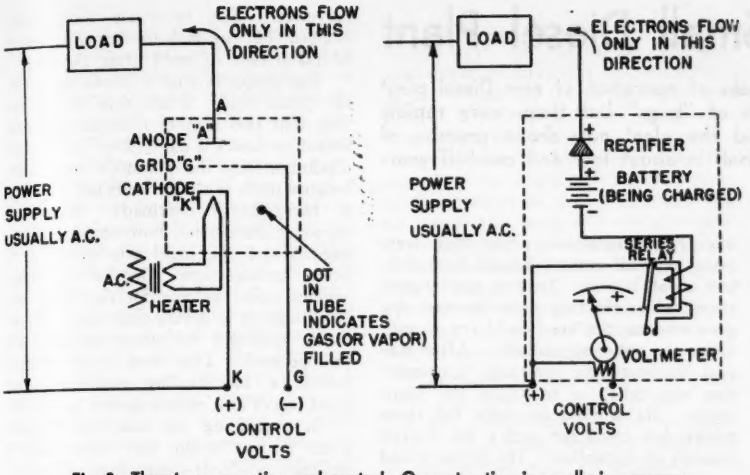


Fig. 3. Thyratron operation and control. Current rating is usually in amperes

ment, the positive terminal of which is connected to the negative terminal of the rheostat. Gear the rheostat to the voltmeter element in such a way that more negative voltage will cut in more resistance (see Fig. 1). The rheostat is stepless, and goes to infinite resistance or open circuit at the high end. It is assumed that the voltmeter and rheostat can move extremely fast, 100,000,000 times per second; and the voltmeter is of extremely high resistance, perhaps a megohm or more.

This simple circuit can be used to replace a triode pliotron in any industrial circuit, and will do exactly the same job. If the tube is a tetrode or pentode, other series rheostat-voltmeter combinations may replace each grid. Nothing particularly tough about this circuit, is there?

Would you like a phototube? Then simply replace the voltmeter with an exposure meter so that increased light on the sensitive surface will move the meter element to cut resistance out of the rheostat (see Fig. 2).

As for the thyratron and ignitron, they are no more complicated. In series with the rectifier we'll place a battery of about 15 v and so connect it that it will be charged by the current which the rectifier permits to pass. (This corresponds to the constant arc drop of the thyratron for all current values.) Finally, in the circuit is a series relay that is connected to "seal-in" or "lock-in," when the circuit is completed through its own single, normally open contact. The relay armature is moved, and this contact is closed mechanically by the action of the control voltmeter (just as the rheostat turned, in the description of the pliotron). The contact moves to close as the voltage becomes less negative (see Fig. 3).

Once the contact has closed, however, the holding power of the series relay is so great that the small voltmeter torque is powerless to open it again until the current has stopped flowing.

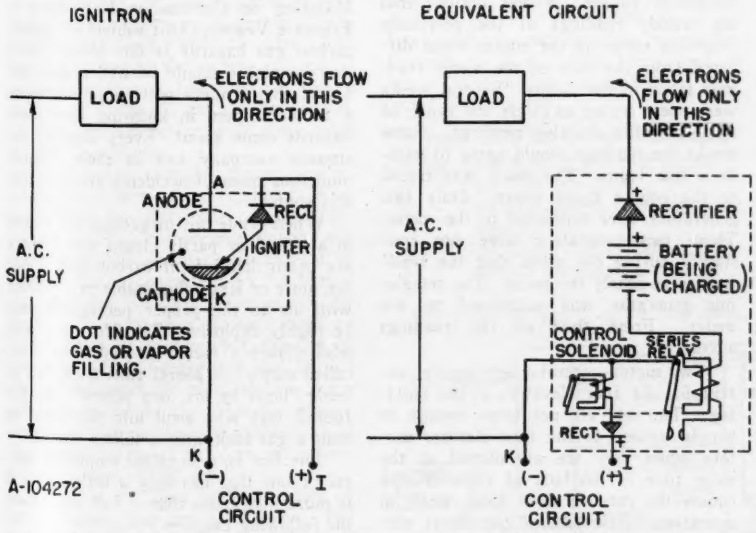


Fig. 4. Ignitron operation and control. Current may be hundreds of amperes

The ignitron equivalent is about the same, except that we must remember that we are dealing with larger power, and the size of everything becomes larger. In place of the voltmeter, we can use a small solenoid. A rectifier in series with the solenoid, to permit current to flow in but one direction, may not be necessary in our electro-mechanical picture, but it is necessary in the ignitron circuit to prevent injury to the igniter by reverse current, so we'll put it in to make our picture complete (see Fig. 4).

And that completes our one-lesson course on the industrial electron tube. We do admit that a few of the details about as essential as trouser cuffs and pocket flaps have been omitted. But the fundamental facts are here, and we would like to prove it in this way. If you ever run into a wiring diagram that features one of these mysterious electron tubes that has been worrying you, do this: Before you lose any sleep or even get a vitamin "B" deficiency, just tear off a piece of an old war bond or ration book, paste it neatly over the offending tube symbol and draw thereon the appropriate equivalent symbol in a bold and steady hand. Then go right ahead and forget that electrons exist.

Overcoming Lubricating Oil Trouble

BY JOSEPH P. O'HERN
Chief Engineer, St. Mary of The Lake Seminary

THIS is an account of how we overcame a lot of trouble in a very simple manner.

We have two 200 hp Ball engines. There is a 6-gallon oil reservoir mounted on the frame. Pipes lead oil to all bearings by gravity feed. The pipes often blocked up with sludge and had to be dismantled and cleaned.

The oil from the bearings drains to the crank pit and is pumped back to the reservoir by a plunger pump connected to the crank. The discharge from the pump goes into the bottom of the reservoir which has about 1/3 water and 2/3 oil in it. There is a 2 in. by 9 in. horizontal screen fastened to the outlet pipe located in the middle of the oil bed. The turbulence from the pump discharge does not let the dirt and water settle out, so a considerable amount got through the screen and blocked up the pipes.

To overcome this, I connected another reservoir alongside and slightly below the old one. This second reservoir with a capacity of about two gallons has a vertical screen 3 in. by 14 in. As there is no turbulence in this reservoir, the sludge and water collect on the screen and fall to the bottom, where it is drawn off a couple of times a week by a petcock. On the oil outlet on top of the second reservoir there is a glass gage about 10 in. high and open at the top. This lets the air out and shows the quantity and condition of the oil. The oil is cleaner and cooler and we have no more clogged-up pipe lines.

Operation of a Small Diesel Plant

First few weeks of operation of new Diesel plant disclosed lots of "bugs" but these were rapidly corrected and the plant now shows promise of paying for itself in about four and one-half years

By TYLER G. HICKS

APPROXIMATELY one year ago the writer was given charge of a small Diesel generating plant consisting of three Cooper Bessemer 10 by 15 in., two-stroke cycle engines, each belted to a 75 kw alternator. The plant was designed to supply both alternating and direct current to the 16-story hotel building. This article will describe the principal features of the operating procedure which has been followed during the past year.

Three hours after the installation work on the first engine had been completed the public utility which had supplied power to the hotel disconnected their lines. The one engine carried the whole lighting load satisfactorily for about one hour, but then the V-belts driving the generator began to slip. Naturally, the voltage dropped. Upon investigation it was found that the generator had moved on its adjustable base, thus permitting the belts to slacken. This condition was corrected by moving the generator back and putting lock washers under the nuts which held it to the base.

After the work had been completed on the other two engines it was thought that little trouble would be experienced

RELIEF VALVE, DUMP TO SEWER COOLING WATER OUTLET
COOLING WATER INLET TO CYLINDERS
WATER FROM CITY MAINS
PRESSURE REGULATING VALVE

Fig. 1. Valve arrangement which cured blackout trouble

when carrying heavy loads. However, several blackouts were caused by air binding on the cylinder water jackets. When an engine became air bound it would overheat very rapidly. The only procedure the operator could follow was to shut down the engine, thus throwing the entire load on the other machine. At this time the voltage regulators were not working. The voltage would fall and the operator would have several tense minutes while trying to shut down one engine, regulate the voltage manually, bleed the system of air, and start another engine. As a consequence, blackouts were frequent, on the average, seven per week. This condition was completely remedied by installing the valves shown in Fig. 1. The diagram is self-explanatory.

Mention has been made of the fact that the voltage regulators were not working. Anyone who has tried to parallel two alternators while they were under manual control knows how difficult a job it was. Trouble was experienced when shutting down because the generator on the line would try to motorize the outgoing machine. After several blackouts the company representative was called in to adjust the regulators. He worked on them for three weeks, but could not secure the desired fineness of regulation. The lights would

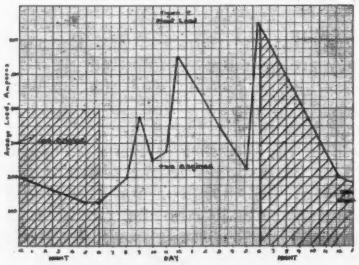


Fig. 2. Graph showing the plant load

flicker continually. Hotel service demands steady lights. Finally it was found that two wires had been crossed in each regulator. Reconnecting these lines gave the proper regulation so that now the maximum variation is plus or minus two volts. No trouble is encountered when cutting a generator in or out because the voltage regulator maintains an exciting current which is proportional to the load on the machine.

After the voltage regulators and cooling water system faults had been corrected, operation of the plant was comparatively simple. It was noticed that the weekly readings of the polyphase watthour meter in the engine room differed from the sum of the meter readings taken in the rooms. Several weeks were spent trying to locate the cause of the difference in the readings. Some weeks the readings would agree to within a few hours. The cause was traced to the engine room meter. Only two generators were connected to the meter. These two generators were run constantly during the week that the readings were nearly the same. The remaining generator was connected to the meter. From then on the readings agreed.

Two motor-generator sets supply current for the four elevators in the building. The sets are not large enough to supply current to the four elevator motors when they are all started at the same time. This lack of capacity also causes the cars to slow down while in operation. Reversals of the direct current generators has been a frequent occurrence. The reversals have been stopped, but the lack of capacity cannot be taken care of until after the war.

The graph in Fig. 2 shows the average plant load. From this it will be seen that two engines must be operated seventeen hours a day. This is an ideal condition, from the operator's standpoint, because there is always sufficient capacity to carry heavy overloads. From the economic standpoint, however, two large engines and one small one would be a better arrangement. One of the large engines could be run all day with the small one cut in during peak loads. After twelve midnight the small engine could be operated. The other large engine would be for standby purposes. The plant hasn't any outside source of power.

In organizing the maintenance program it was noted that there was a tendency to "over-clean, over-lubricate," and in general spend more time than was necessary on the generating plant. After considerable thought the program was revised. At the present time each operator is held responsible for the cleanliness of one engine and the area around it. As a result the men have more time to devote to other work.

The comparative cost of buying and generating current for this building is as follows:

	Utility	Plant
Cost of 300,000 kw hr...	$15,000	$6,000

The total investment on the plant amounts to approximately $50,000. As can be seen from the table, the plant will pay itself off within six years. During this time the hotel will receive all its hall, lobby, kitchen, basement, and service room electricity free. Taking this into account, the time required will be four and one-half years.

Hydro-Carbon Gas Hazards

By C. C. Custer

In a recent issue of POWER PLANT ENGINEERING we note an article by O. W. Malarkey on Combustion Explosions in Pressure Vessels. This subject of hydrocarbon gas hazards is one about which every engineer should be well posted and I feel that readers will be interested to a further extent in knowing how these hazards come about. Every casualty insurance company has in their records numerous cases of accidents arising from this source.

When crude oils or greases are stored in a closed or partly closed vessel there are often distilled off carbon gases that are more or less inflammable or if mixed with air to the proper percentage may be highly explosive. Therefore the man who strikes a match to look into a so-called empty oil barrel runs a chance of being "hoist by his own petard" like the foolish man who went into the cellar to hunt a gas leak with a tallow candle.

The fact is, a so-called empty oil barrel or one that has only a little oil in it is more dangerous than a full one. Note the following cases,—

Case 1. A man running a garage had

a surplus of spent crank case oil which he was going to utilize to heat his garage in cold weather. He rigged up an old oil drum on a box not far from the stove into which to put his crank case oil. He equipped the firebox of his stove with a common gas burner and piped over from the bottom of the barrel a small pipe line to carry the fuel, having a check valve in this line which he said was to keep the stove from back-firing into the barrel. This worked all right for a time till one day he used a batch of oil that must have had a percentage of gasoline in it as is often found in crank-case oil. After the fire had been burning for a while there was a terrific explosion,—the barrel blew up scattering burning oil all over the place and badly burning a couple of men who were in the shop. We explain this as follows,—The stove had not back-fired into the supply tank through the oil supply line but a gas had distilled off the top of the barrel out into the room and the draft of air being drawn toward the stove, ignited and back-fired through the air into the barrel. Thus floating hydrocarbon gases in the air are subject to spontaneous combustion or easily touched off by any open flame.

Case 2. An engineer had a large storage tank on the hill just back of his plant which was used to store crude oil used as fuel. His house was further up on the hillside and afterward he planned to use the same oil to heat the residence. Having air compressors in his plant, he planned to put a pressure air-cushion on top his oil in the tank and thus force it up the hill to be used at his residence. This worked all right for a time until there was an explosion in the tank that blew its top off. No one seemed to know just what caused it, but I think the reader can form his own conclusions. I think he must have had a mixture in the top of the tank of compressed air and hydro-carbon gas like the charge in a Diesel engine. Thus he was monkeying with potential dynamite.

Case No. 3. We were operating several air-compressors and pumping a number of deep wells with air lifts. The night attendant at the station ran out of compressor oil and being too lazy to go to the oil house to get the proper oil, he filled the lubricator with some colza oil that was handy.

Be it known that the proper type of oil to use to lubricate air cylinders is an oil of high fire test. The colza oil carbonized in the compressor valves and made them stick on their seats and fail to function till the parts got so hot that it started a fire and explosion in the air mains. There seemed to have been an accumulation of carbon on the inside of the pipes which caught fire and burned off. This heated the pipes so they were very hot to the touch. Also the accompanying explosion blew the gaskets out of the flanged joints of the 6 in. air mains, for a distance of 100 yd.

Case No. 4. This really consists of several cases that are all similar. We were looking at an air reservoir tank which was equipped with a safety valve, and noted that the paint on the outside of the valve was burned off. The engineer explained that they had gotten hold of the wrong oil to lubricate the compressor cylinders and the safety valve had blown off and there had come a stream of fire out the safety valve that resembled the operation of a blow-torch. In this connection it may be stated that air compressor reservoirs are also sometimes equipped with fusible plugs so that on occasions when carbon deposits on inside of tanks burn out the extra heat evolved will blow the fusible plug and thus call the engineer's attention to abnormal operating conditions.

The moral of the whole thing seems to be that you are inviting trouble when you mix compressed air and hydrocarbons. Oil storage tanks carrying crude oil on railroad cars are equipped with low pressure safety valves on top. These valves are there to let out any excess pressures that may accumulate but prevent the air from entering.

Be careful how you handle hydrocarbons.

Need a Boiler Compound? Here's a Swell Formula

By Morris Bradt
Chief Field Engineer
Skinner Engine Company

IN GOING over some old files, recently, we ran across the boiler compound shown below. It amused us and we felt that present-day engineers would be interested in knowing exactly how a proper boiler compound should be made up.

This formula was purchased for use in the plant of the Skinner Engine Co. a number of years ago. Unfortunately we do not have the date that it was purchased but it is still, in our opinion, an antique. Here is the formula exactly as it was written:

* * * * *

I hereby guarantee this formula to be genuine, and in accordance with my affidavit shown you. The purchaser, by the acceptance of same, agrees to regard this formula as a shop-right only, and to caution whoever may prepare this compound accordingly.

Formula, 200 lbs Boiler Compound

160	lbs.	Soda Ash, 58 per cent strong
20	"	Fine Oak Saw Dust
10	"	Fine Bone Black, Common Quality
10	"	Sulphate of Copper, Small Crystals or Granulated.
200		

Get a bag or barrel of the saw dust, sift it through a large size No. 10 or 12 mesh wire riddle, throwing away the coarse refuse. Weigh the required quantity in any box or barrel, and leave it there. Dissolve the Sulphate of Copper in a large pail or crock in about 3½ gal of scalding hot water, stirring and crushing constantly with a stick until thoroughly dissolved. Pour this into the box or barrel containing the saw dust, and mix quickly with a stick simply to saturate the saw dust. Dump the wet saw dust on the floor, add the bone black and mix with a shovel or rake until it turns black, Now, add the soda ash, and mix until it turns grey. To avoid chips, nails, etc., better sift the whole mixture on a clean part of the floor, crushing the lumps through riddle with a small block of wood, and there will be but little refuse. Spread and let dry for an hour and it will never cake or harden.

A rake is an excellent tool for mixing. Attach a 5 ft handle of some kind to the riddle, and let it rest on the edge of a box or something about waist-high while using, and this relieves you of the weight. If you mix less than 200 lbs, don't forget to reduce the quantity of water proportionately.

DIRECTIONS FOR ENGINEER: Keep covered in a dry place. Use freely, and it cannot fail to do the work. To remove scale, about ⅛ lb per horse-power should be used once a week. A small quantity will prevent the formation of scale. After washing out two or three times, you can easily determine the necessary quantity. When boilers are open, put the dry powder into the boilers. To pump or inject the compound, first dissolve it in scalding hot water.

GEO. PEOPLES (signed)
130 Carolina St., Buffalo, N. Y.

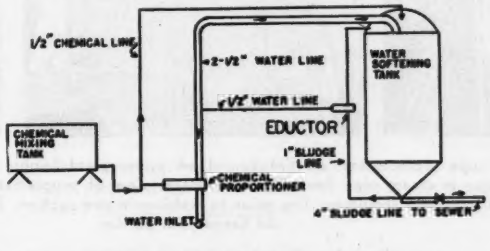
Get all but the saw dust at Plimpton, Cowan & Co., Buffalo, N. Y., and the saw dust at any planing mill or wherever oak is sawed up.

* * * * *

Eductor Solves Sludge Recirculating Problem

By G. F. Suchy

SLUDGE recirculation is required for the silica treatment we use and the attached sketch shows an eductor I installed for this recirculation. It has proven very satisfactory for several reasons. First, it eliminates the use of a pump. Second, there is no operating cost since the operating water is taken off the discharge of the proportioners. Third, the chemical treatment ratio remains unchanged.



Eductor installed in sludge recirculating line of a softening system eliminates the need for a pump

Arc Welding Saves Time In Pipe Line Erection

Temporary steam line removed and new line installed in record time . . . Ladder supports lines during welding and cutting operations . . . Supplementary line replaced in an hour

USING WELDING EQUIPMENT supplied by The Lincoln Electric Co., Cleveland, Ohio, the maintenance department of The McGean Chemical Co. removed a temporary steam line and installed a permanent line in a few hours while the plant was not in active production.

The sequence of operations necessary to effect this line replacement was carefully worked out so that the job required a minimum of time.

A general view of the span of pipe line between the power plant and the main building is shown in Fig. 1. The welder in this photograph is fusing a 4-ft section of pipe into the 6-in. diam pipe line. The line normally carries about 160 lb steam pressure and is heavily insulated.

After bevelling the ends of the pipe at the joint and tack welding the section into place, the pipe was finish welded as shown in Fig. 2, using $\frac{3}{16}$-in. electrode with 3 passes.

A supplementary 4-in. diam line was also erected from the new main building to another section of the plant, replacing the original line with a flanged coupling.

In order to replace the old coupling with a permanent, welded pipe section, a temporary line was connected just above the coupling and steam was shut off at the coupling joint to prevent it from passing into the pipe line below. The flange and temporary, board-covered line are shown in Fig. 3.

A ladder was used to support the long length of pipe (see Fig. 4) and the flange section and temporary line were flame cut and removed as shown in Fig. 4.

A new section about 15 in. in length was then arc welded (see Fig. 5) to make a permanent, rigid and leak proof pipe line.

Replacement of the complete supplementary line required only about one hour.

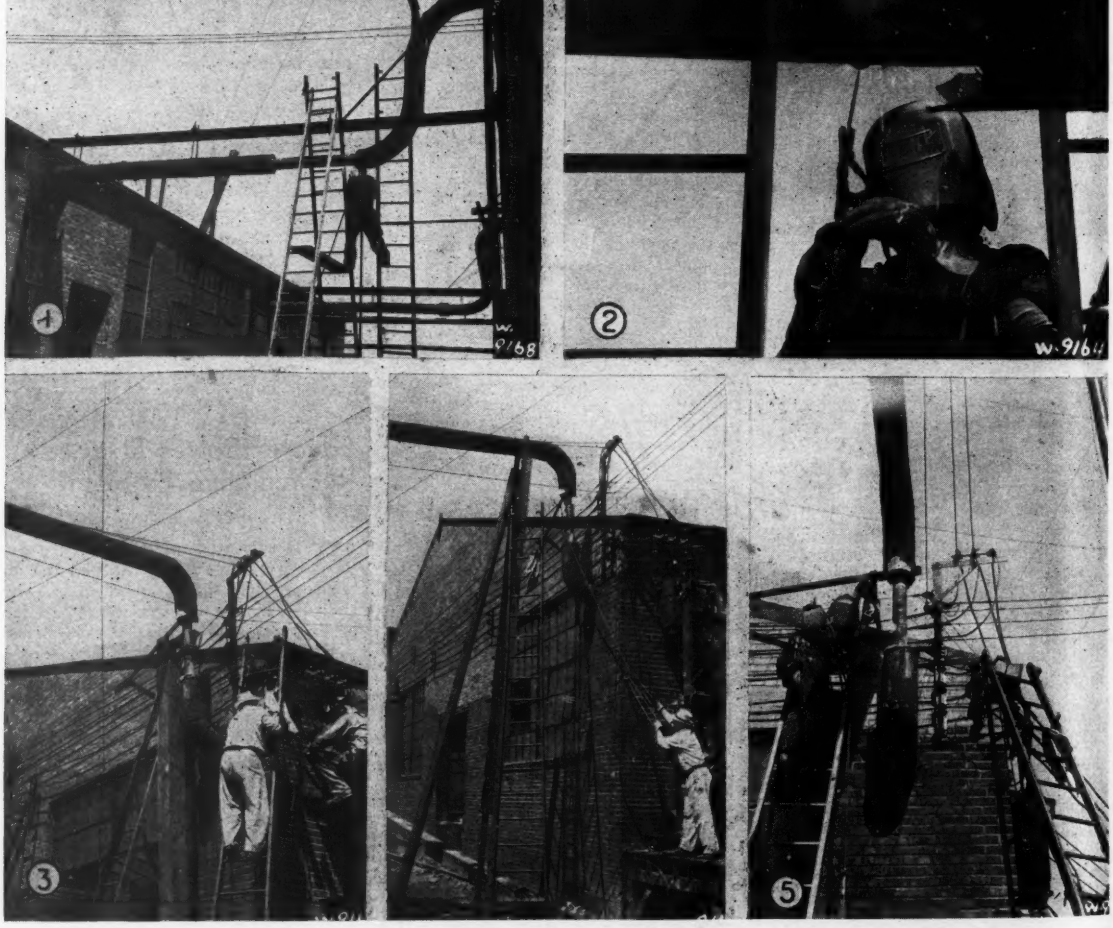


Fig. 1. General view of welded pipe replacement job between steam power plant (right) and new building (left). Fig. 2. Welding the final bead on a 4-ft section of pipe in steam pipe line. Fig. 3. General view of supplementary line showing temporary line and flanged joint. Fig. 4. Removal of flanged joint and temporary line prior to welding in new section. Fig. 5. Finish welding the new section to replace old flange joint portion

Recirculation of Boiler Water for Preventing Corrosion*

Recirculation is employed to overcome corrosion in feed pumps, feed lines and economizers, chiefly in plants having a high percentage of returned condensate. To be effective, water must be low in solids

By R. B. CONLAN
Chemical Engineering Staff
W. H. and L. D. Betz

THE RECIRCULATION of boiler water for corrosion prevention consists in continuously drawing off controlled quantities of boiler water and returning it to the boiler feed line, either before or after the boiler feedwater pump. This is done in order to increase the pH and the alkalinity of the boiler feedwater, thus providing protection against corrosion.

Unlike recirculation of boiler water to hot process softeners, which may amount to as much as 10 per cent of the total boiler feedwater, under normal operating conditions the recirculation of from 1 to 2 per cent of the boiler water is sufficient to offer satisfactory protection against corrosion.

Use or Purpose

In systems where a high percentage of returned condensate is used, or where evaporated make-up water is employed, low pH values of the feedwater may cause corrosion of the feed pump, feed lines, and economizers. Even properly deaerated boiler feedwater may possess corrosive tendencies due to the low solids content and the relatively low pH. Where small amounts of dissolved oxygen are present in the boiler feedwater, the corrosive activity of the oxygen is further enhanced by low pH values. Of two waters, each containing equal quantities of dissolved oxygen, the water with the lower pH is the more corrosive.

Although alkaline chemicals, such as sodium hydroxide (caustic soda), can be fed continuously to the boiler feedwater to elevate the pH, this procedure may be undesirable because of the increased alkalinity of the boiler water. The solids content of the boiler water may also be increased excessively.

By returning to the feed line a small portion of the alkaline boiler water from the continuous blow down line, an increase in the pH of the feedwater is accomplished. Thus, the likelihood of corrosion is reduced without the use of additional treatment chemicals and without further adding to the solids content of the system. In systems where sodium sulfite is fed, a further advantage is secured in that excess sulfite in the boiler water is also recirculated through the feed line. Thus, a longer contact time is possible for the reaction of sodium sulfite with dissolved oxygen.

Chemistry Involved

Because of the unbuffeted nature of the feedwater, a small portion of the boiler water will cause a considerable increase in pH value.

It has been demonstrated that iron is least soluble in distilled water at a pH of 9.6. Although it would be desirable to obtain this pH for the protection of the ferrous metals in the system, the characteristics of the other metals employed, such as brass and bronze in feed pump construction, do not permit the maintenance of pH values in excess of 9.0. When the corrosive tendencies of all metals employed in the system are taken into consideration, an average pH of approximately 8.6 is desired for best results. Hence, when boiler water is recirculated, the alkalinity and pH value of the feedwater are increased, and even though the pH is not permitted to rise above 8.6, ferrous metal ions are less likely to go into solution at the increased pH than at the original pH value of the feedwater. As was previously stated, the same effect could be accomplished by feeding sodium hydroxide. However, the boiler water alkalinity would be increased proportionately, thus necessitating an increased rate of blow down.

Of course, where the recirculated boiler water is introduced after the boiler feed pump, such as to the economizer inlet, the metals employed in feed pump construction need not be considered as limiting the pH of the boiler feedwater. Control of the quantity of recirculated boiler water, therefore, is not dependent on the prevention of high pH values of the boiler feedwater.

To determine the quantity of boiler water to be recirculated, a measured amount of boiler feedwater is titrated with boiler water; the pH value being read after each ml addition of boiler water. Thus the amount of boiler water necessary to establish the desired pH can be calculated and the blow down flow control valve set accordingly. Control of recirculation should be based on frequent tests for the pH of the feedwater mixture and regulation of the flow control valve adjusted accordingly. Determination of the phenolphthalein alkalinity of the feedwater mixture can also be employed for control purposes.

As mentioned above, the recirculation of boiler water also introduces excess sodium sulfite to the boiler feedwater, if this oxygen-reducing chemical is in use. Since the speed of reaction between sodium sulfite and dissolved oxygen is increased by excess quantities of sodium sulfite, boiler water recirculation assists in the rapid completion of this reaction and affords increased protection of the boiler feed lines, economizers, etc.

Mechanical Equipment

The initial installation for recirculation is essentially simple since it embodies a line running from the continuous blow down and regulated by a conventional flow control valve. In order to avoid difficulty with regulation of recirculation and continuous blow down, it is preferable, however, to employ two independent lines, since less attention and adjustment will be required.

If the boiler water is to be returned to the economizer inlet, a pump will be necessary. This arrangement is desirable in cases where there is danger of increasing the pH value too high for feed pump metals, such as bronze. With direct return of boiler water to the economizer, an excess of boiler water can be recirculated without the need for frequent pH determination of the feedwater mixture or frequent adjustment of the regulating valve.

When the boiler water is recirculated to the suction side of the boiler feed pump, such as to the storage compartment of the feedwater heater, an additional pump is not necessary. Feedwater and boiler water can be mixed thoroughly in the heater storage compartment and protection against corrosion is given the storage tank, since excess sulfite can react here to chemically remove dissolved oxygen. The recirculated boiler water is always introduced after deaeration of the boiler feedwater in order to avoid loss of sodium sulfite or "fixing" of free carbon dioxide by reaction with the sodium hydroxide content of the boiler water. Where recirculated boiler water is to be introduced prior to the boiler feed pump, the ideal point for this introduction is the storage section of the feedwater heater.

The most desirable arrangement where the boiler water is returned prior to the boiler feed pump would be one which would proportion the recirculated boiler water to the feedwater. This proportional recirculation is particularly desirable where marked load variations are encountered which render manual regulation difficult. With the use of automatic pH control devices, proportional recirculation can be accomplished.

Applications

Recirculation is employed to overcome corrosion in feed pumps, feed lines, and economizers, chiefly in plants having a high percentage of returned condensate or where the pH value of the feedwater is low. In order that recirculation may be effective, the feedwater must be low in solids content

*Abstract of an article in the Betz Indicator.

so that a high percentage of boiler water will not be needed to attain the desired pH.

Limitations

Where boiler water is recirculated prior to the boiler feed pump, pumping costs also increase inasmuch as the quantity of feedwater for a given steam production increases directly with the amount of boiler water recirculated. Although the heat contained in the recirculated boiler water is returned to the system, some loss is encountered because of the heat degradation involved.

Where boiler water is recirculated to the economizer inlet, a special pump is required to handle the alkaline boiler water at high temperature and pressure. However, only sufficient pump power is required to overcome the pressure drop through the economizer. This power requirement is less, of course, than is necessary to pump the recirculated boiler water from heater pressure to feedwater pressure.

Recirculation of boiler water for corrosion prevention should be restricted to systems employing high percentages of returned condensate, evaporated or zeolite softened make-up water. Under these circumstances, the suspended solids content of the boiler water will be only a negligible quantity. Where the boiler feedwater contains any appreciable hardness, so that the suspended solids content of the boiler water will be high, recirculation for corrosion prevention should not be attempted.

Where boiler feedwater is employed in desuperheating, the use of recirculation may sufficiently increase the solids content of the feedwater as to cause troublesome deposits in the desuperheater or if desuperheated steam is employed in turbines, may cause deposits on the turbine blading. It may be necessary in such cases to install separate facilities for replacing feedwater with condensate for desuperheating.

The amount of boiler water recirculated should be confined to 1 and 2 per cent of the total feedwater. When larger quantities are needed to obtain the desired pH value, such as in cases of condenser leakage, the solids content of the feedwater will increase markedly. Increased feedwater solids may have an abrasive action on the feed pump and the alkalinity and excess phosphate content of the boiler water may cause feed line deposits.

PRACTICAL HINTS AND KINKS

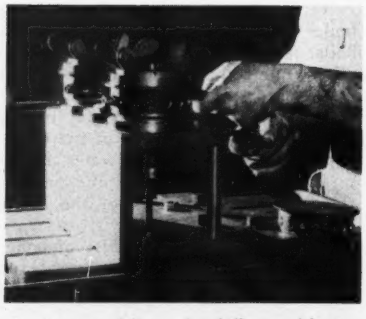
Double Indexing Fixture For Drilling

A DOUBLE INDEXING fixture which facilitates machining close-tolerance holes at specified intervals about the circumference of a small, round aluminum housing has been devised at the General Electric Company's Schenectady Works. The housing is composed of an upper and lower section and when the holes, each 0.503 in. in diam, are machined, one-half of each hole appears in both sections.

Formerly, this operation consisted of spot drilling and reaming in a drill jig. The jig was clamped centrally with the spindle and each hole indexed in turn. The specified smooth finish was difficult to produce, the fixture was hard to keep clean, and the jig had a high maintenance factor, having been rebuilt five times. Moreover, for best results in assembly, experienced operators and assemblers were required to remove the burr caused by reaming.

The new fixture, designed for use on a double head Borematic machine, has solved the problem. Special twin boring bars, with drill tips inserted to pilot the boring tool, are used with the fixture, which is mounted on a channel-shaped fabrication of three-fourths-inch steel plate, with a bottom side longer than the top. The bottom of the plate acts as a base for holding the indexing mechanism and the shorter top serves as a mount for the work. The upper extension is supported by two posts at each end, as well as by the connecting side of the channel section.

The indexing mechanism consists of a 16-hole index plate assembled to a centered spur gear, at each side of which



Showing use of fixture for drilling and boring

are gears of equal diameter. The center distance of the shafts, to which the other gears are attached, is within the adjustable range of the machine heads, and thus permits machining two pieces, side by side, simultaneously.

Attached to each shaft is a mounting plate with a short locating pin for each piece. The pieces are positioned over each shaft, the diameter of which permits easy loading and unloading. A large flat washer distributes the holding pressure applied by threading a four-winged nut over the end of each shaft.

Each piece is indexed by first releasing a long vertical locking pin extending from the enclosed index plate to the base plate of the fixture. This is done through lever action of the lower attached handle. Next, the upper handle, operated horizontally, in the manner of a ratchet from the center of the mechanism, serves to position each succeeding pair of holes for machining. A pin is inserted in the first hole after drilling and boring, as a precaution against possible movement of pieces in the fixture.

This method has reduced the time for this operation from 30 minutes to four and one-half minutes. It also results in a reduction of assembly time because of a higher degree of accuracy, uniformity and finish of the holes.

Pipe Threading Machine Made from Scrap Metal

By Denard L. Gusler

THE CHIEF MECHANIC, at a plant where I used to work, constructed a pipe threading machine almost entirely of scrap metal that resulted in a considerable saving in money and the labor usually necessary to manually operate a die stock.

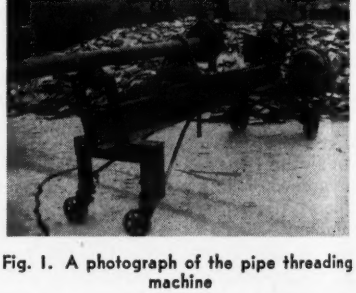


Fig. 1. A photograph of the pipe threading machine

The general features of the construction are well illustrated in the photograph, Fig. 1, and the drawing, Fig. 2, is merely intended to supplement any details not made clear in the photograph.

The Chief simply bolted together two 9-ft lengths of 8-in. channel iron, with 1½-in. pipe nipples holding the channel sections apart, and mounted the arrangement as shown in Fig. 2 on a framework of angle iron, pipe braces, and truck wheels. He then made forms to have castings made for the cast-iron heading housing, pipe vise, and traveling guide to carry the pipe vise. An old Chevrolet transmission was found and mounted in brackets as shown. Most any type of universal coupling of adequate size can be used between the transmission and die stock.

It is necessary that the square coupling be machined to a close fit because the changing angularity of the drive shaft causes the traveling guide and die stock to oscillate slightly and friction resulting from transmission of power through the coupling holds the

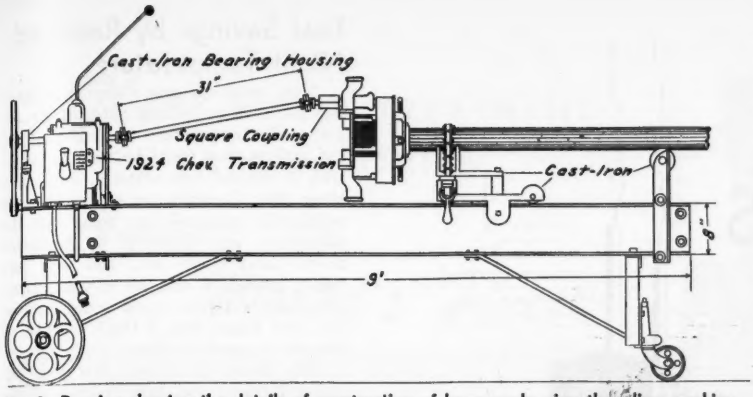


Fig. 2. Drawing showing the details of construction of home-made pipe threading machine

die stock and drive shaft together. No clamps of any kind are necessary.

The small pulley is 2⅝ in. dia and the large pulley is 13 in. dia. The gears are shifted to reverse to thread and low gear forward to back off. It is necessary to keep plenty of oil on the cutters and pipe while threading is taking place.

The motor is 3 phase, 900 rpm, and controlled by an across-the-line starter. We had receptacles located throughout the plant so that our electric welder could be used wherever necessary and the pipe threading machine could be rolled wherever needed and used in the same manner.

Another desirable feature is the pipe vise mounted and carried with the machine so that it is unnecessary to set up the usual clumsy table. We used a Beaver die stock and pipe diameters from 2½ to 6 in. can easily be threaded.

Care of Fire Extinguishers

SEVERAL COMMON types of fire extinguishers are subject to freezing and, if allowed to do so, may be rendered inoperative or even dangerous to use.

Soda-acid, foam and gas cartridge extinguishers must be kept in relatively warm locations (above 40 F to be safe) or in suitably heated cabinets. The National Board of Fire Underwriters specifies that cabinets for use in sub-zero climates be of ⅞ in. double wall construction and be heated by a continuously burning incandescent lamp of not less than 50 watts Single-wall enclosures, similarly heated, are suggested for locations where temperatures below zero Fahrenheit are not encountered.

Anti-freeze chemicals, such as common salt, calcium chloride and glycerine, should not be added to extinguishers of these types, since foreign ingredients may reduce the effectiveness or change the nature of the discharge, or corrode the parts and make the extinguishers dangerous to use.

Pump tank and gas cartridge extinguishers can be protected by adding anti-freeze chemicals supplied by the manufacturer. Chemicals other than these should not be used, however, as they may cause corrosion.

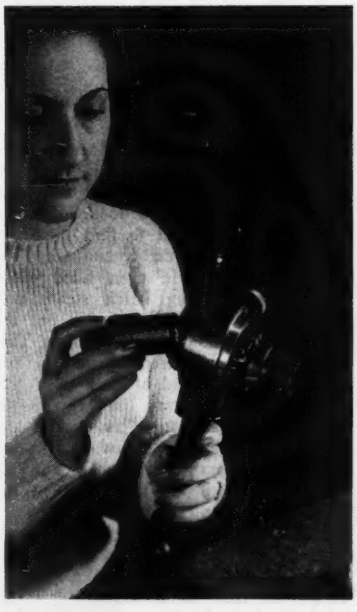
Extinguishers which do not require protection from freezing are the vaporizing liquid, carbon dioxide, and loaded stream types. The first two contain no water; the latter does contain water, but has chemicals added which depress the freezing point.

Forewoman Solves Assembly Problem

A DOUBLE forming fixture devised by Victoria Abbott, a forewoman at a General Electric plant, halved the time needed to assemble random-wound coils to the stator cores of small instrument-type motors and made the operation easy for new assemblers to master.

The core must be shaped and bound at its two sides. Previously, the coils on one side were packed around a forming plug, after which the plug was removed and inserted in the other side. Frequently the binding and shaping operation on the second side would force the turns on the first side out of shape. The operation depended largely on trial and error, and was difficult even for experienced operators.

Miss Abbott solved the difficulty simply by designing a pair of forming plugs which couple by telescoping inside the core, making it possible to shape and bind both sides before removing either plug.



Miss Abbott removing one of the telescoping forming plugs from a core and coil assembly

Saving Rubber, Lumber, Glass

By J. R. Kennedy

STORE RUBBER hose in a dark place, away from light and heat. Rubber exposed to sunlight soon shows cracks. Don't hang a rubber hose on a nail near a window. The nail will cause a kink, followed by a break. The sunlight may strike the hose through the window a short time each day. Store rubber gaskets and tubing as carefully as large rubber articles, because cracked or hardened rubber gaskets are sometimes worse than useless. For instance, gage-glass gaskets, when hardened from age or other causes, often crush the gage glass when the packing nut is tightened instead of making a steam-tight joint, as would be made by pliable gaskets under packing nut pressure before crushing the gage glass. Old or cracked gaskets should be removed instead of trying to save them often at the expense of a cracked gage glass. Don't store rubber where it will be exposed to waste oil or grease. Letting a valuable rubber hose lie in a puddle of oil in some corner of the plant is much like spilling battery acid on a fine pair of dress pants.

Practically all waste of lumber can be eliminated by careful planning and forethought before cutting a full-length plank in two. For instance, in ceiling or weatherboarding a room containing a number of windows, it is often possible to select lengths in such a manner that cut-offs (which usually go into the scrap heap) are all used. Let's suppose one needs a number of four-foot cut-offs between a window and a corner. The window is located in the end of the room which is 12 ft by 20 ft. Two 12-ft planks reach the length of the room and provide a four-foot cut-off, while a 12-ft plank and a 14-ft plank would yield a 6-ft cut-off, causing a waste of two feet when the cut-off is used between the window and the corner referred to above. Selective cutting is required in carpentry if waste is to be avoided, but this requires patience. The recent freezing order on lumber may help a number of wasteful persons to develop such patience. The idea explained above is applicable throughout the construction of a building. It may be easy to avoid waste if the lumber on the job is just what the bill called for, but it is rare to find just what one wants these days if the lumber can be obtained at all. Therefore, we must learn to use what we have and not waste it.

Breakage of glass, such as gage glasses, sight-feed glasses, etc., can best be avoided by giving early attention to glasses that need fresh packing. Late attention usually results in packing failure, followed by breakage of the glass during the blowout, especially in the case of gage glasses under water and steam pressure.

LETTERS AND COMMENTS

Million Dollar Plants vs. $1500 Men

YOUR PROVOCATIVE ARTICLE, "Million Dollar Plants, etc" was of great interest to the writer. It reminds him of the old riddle, "Which came first, the chicken or the egg?"

In our case, we can well ask, "Which will come first, the more competent man, or the higher salary?" And from the general conditions brought forth by this war, the answer will not come soon. While a few concerns have taken some steps forward in employee training, the great majority of employers are woefully lax in that respect. As for the average worker, may God help us, and him, if he does not change his ways, and take more interest in his work.

The employer asks, "Why should I pay more and get less?" And the employee asks, "Why should I give more, and get less return?" A very logical answer to both of the above questions can be given in two words, "Gentlemen, cooperate." But with the average employer and the average union leader battling viciously with each other, the attainment of such cooperation is of course impossible.

The union credo of one man being worth as much as another, and the union prostitution of the economic principle, "division of labor," certainly spells death to incentive. Furthermore, the lax attitude of many employers, evidenced by their failure to work out an incentive plan based upon merit and ability, does not aid the situation.

Can you imagine an organization operating some 60 plants and completely without a merit system? Promotion being made by the "Who you know plan"? Or, an organization in which certain employees are openly recognized as being most efficient and capable, and are as openly shunted to one side to make room for the rank nincompoops? Or, a union that forces an employer to hire the most unenlightened dimwits?

These conditions all exist today.

What shall we do about it? Shall I, a laboring man, and my employer cooperate, and recognizing each other's worth, give to each other his just due? Or shall we continue upon our path of destruction, endangering ourselves and our country?

Wingdale, N. Y. SAM WILLIAMS

He Was Afraid of NH_3

WHEN BILL MULLEN speaks about new men in his letter on page 98 of the November issue, he is on good ground but he really has not begun to scratch the surface. It came to the point here that I had to tell my boss that if I got any more "wise guys" to break in, I would just forget where I worked.

Some time ago I had one of these fellows given to me to break in. He had a first class license but it is a mystery to me how he got it. This happens to be a refrigerating plant and why a license is issued to any man without refrigeration experience, I don't know, but this man apparently had never been in a refrigeration plant.

I tried for six days to drum something about the plant into this man's head, but it was no use. He would not have anything but that the shell and tube brine cooler was full of water. The compressors were brine pumps and the condensers were water coolers. I instructed him to dump the accumulated oil in the filter and he said he could not do this because it was full. In about a half hour he looked in and was greatly surprised to find the dirty oil container partly empty and asked me where it went. He even filled every oil cup on the big Frick steam unit with cold cylinder oil and also put the same oil in the ammonia oil pumps. This machine had just been overhauled and needed the right kind of oil in the right place. He looked at the top of the vertical shell and tube condensers and told me the water was low. He didn't know it was passing through the spreaders and down inside the tubes. What made me completely nuts was when I told him to help me change a couple of drums of NH_3. He said, "Nothing doing, wait till I get out of here. I'm afraid of that damn stuff!" He certainly had 6 days' pay given to him because he was not worth 6 cents.

ROBERT BAKER

Fuel Savings by Reduced Night Temperature

LAST YEAR you ran a contest regarding the savings in fuel effected by reducing the temperature to 65 F and also the savings that could be made at night with a reduced temperature. I wrote a letter that brought out a number of points, the principal one being that the savings, if any, depended on conditions as to construction, etc., and was fortunate enough to win one of your prizes. This winter I have made some tests on my own house that I think will be of interest to your readers.

The house is a two year old, one story, 4 rooms and bath frame building about 26 by 28 ft with unfinished attic. Walls are square edge boards on studs covered with building paper under wood shingles. The inside walls are hard plaster on wood lath. There is no insulation in the walls. The ceiling is hard plaster on wood lath with 3 to 4 in. of pellet type rock wool insulation packed in between the timbers. The cellar is of concrete blocks, well pointed and tight and the floor is cemented. The three 3 light cellar windows have storm sash. The temperature as noted at various times was between 53 and 60 degrees. The first floor is double with paper in between. There is no plaster ceiling in the cellar.

All windows are fitted with outside storm sash tightly screwed on, with felt gaskets between frame and sash. The two storm windows for the bedroom, however, are hinged at the top and clamped about one-quarter the distance from the bottom. These also have felt but the sash are not held quite as tight as the remainder. The front door is wood, paneled, without glass, but fitted with metal weather strip. Outside of this is a combination door having a large glass area. The rear door is a panel door having one square light of glass and a metal weather strip on bottom only. A similar door, without weather stripping is used as a storm door.

The house faces north and the exposure is considerable. A fireplace in the living room is fitted with a damper kept shut at all times.

The heating system consists of a forced hot air outfit with 5 heating openings for hot air and 4 intakes for cold air, all located in outside walls close to the floor. There is no insulation on the metal air ducts in the cellar. The source of heat is a gun type oil burner having a nozzle rated at 1¼ gal per hr.

A watthour meter with a special register that can be read to 1/100 kilowatthour measures the electrical input to the heating system and this reading is, of course, directly proportional to the oil consumed. Two thermostats for control are in use, one set at 70 F, the other at 55 F and either or both may be controlled by a time clock. Outside temperatures were determined by a maximum and minimum thermometer that was reset every evening at 10:30.

The tests were conducted as follows. During one 24 hour period, beginning

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at 10:30 P.M., the house was maintained at 70 F, with the exception that the bedroom was closed off and the heating ducts closed at about 10:30. One or more windows were opened. At 6:30 A.M. the windows were closed and the door and heating ducts opened. The watthour meter was read at the beginning and end of the 24 hour period, always at 10:30 P.M.

During the next 24 hours the time clock disconnected the 70 F thermostat at 10:30 P.M. and the system operated on the 55 F one until 6:00 A.M. when the clock put the 70 F one back in service. The bedroom operation was always the same. Watthour readings were taken every 24 hours.

Date	Time	Read.	Kwhr 70°	Kwhr 55°	Min Temp	Max Temp	Weather	Wind
12–17–43	10:30 P.M.	604.02						
18	"	606.18		2.16	18	43	Fair	N.W. Lt.
19	"	608.85	2.67		18	42	"	N.W. Lt.
20	"	611.15		2.30	18	39	"	N.W. Gales
21	"	614.26	3.11		17	45	"	W. Gales
22	"	616.84		2.58	14	37	Cloudy	W. Lt.
23	"	620.87	4.03		—5	13	Fair	N.W. Lt.
24	"	624.17		3.30	—8	23	"	N.W. Lt.
25	"	627.82	3.65		8	37	"	W. Lt.
26	"	630.16		2.34	13	50	Cloudy	W. Lt.

The following period was run at 70 F, the next with the reduction to 55 F and this alternation was carried on to the end of the test, in order to offset as far as possible the effect of changes in the outside weather conditions. The log of the tests is given in the following table.

The above results may be treated in various ways. I took the kwhr for each day of each method of operation and averaged them, obtaining 3.36 for the 70 F periods and 2.54 for the periods with the temperature reduced to 55 F at night.

The minimum and maximum outside temperatures for each period were averaged, resulting in 21.75 for the full 70 F period and 24.5 F for the reduced period.

It will be noted that there is a difference of 2.75 F in the average difference between the inside 70 F temperature and the outside temperature during the two test periods. That is, it was 6 per cent colder during the 70 F tests and the power used in the reduced temperature period should be increased by this 6 per cent in order to make the tests comparable. Therefore the correct power used for the reduced temperature is 2.54 × 1.06 or 2.70 kwhr. The difference between 3.36 and 2.70 is 0.66 kwhr.

From this we may conclude that it takes 19.5 per cent less oil (66 divided by 336) if the temperature is allowed to fall to 55 F during the 7½ hours in the night than it does to maintain 70 F the full 24 hours.

Using the lower figure as a reference it would take 24.5 per cent more oil (66 divided by 270) to maintain 70 F during the entire 24 hours than is needed to maintain a reduced temperature during the night.

These results are quite surprising as no such savings were anticipated. The house is as well built as 90 per cent of those in this vicinity and the actual oil consumption for this year's heating season up to December 13 was only 150 gal. It is realized that there are flaws and errors in these tests but the results show conclusively that there is a very great saving made by reducing the temperature at night to 55 F. This temperature might be too low under some conditions, but having the time clock control it was not objectionable in my case since the house was warm in the morning. If the temperature had been reduced to 65 F or 60 F the saving would have been less but it would have been well worth while. I would have liked to run tests at these temperatures and continued all tests at least thirty days but due to the oil conditions in Massachusetts it was not possible.

PRESCOTT R. NICHOLS

More About Work Schedules

THE WRITER is greatly interested in the work schedules for one six-day week shown on pages 94 and 95 of October POWER PLANT ENGINEERING. (Reprinted here for convenience.) The schedule by Mr. Ben H. Whitehouse shown in Fig. 3 on page 95 is particularly interesting. I noted from the text of the article that "No man is required to leave work and return within less than 16 hr. No man is required to work more than 8 hr without relief." Referring to Mr. Whitehouse's schedule you will note on Sunday, July 18, the D shift worked from 4 P. M. until midnight, and likewise worked from midnight until 8 A. M. of Monday, July 19. This would appear to be a double shift, and apparently in conflict with the text. This again occurred on Monday, July 26, and July 27.

Except for the apparent discrepancies this shift can probably be used in one of the writer's plants. It will be of assistance if you would have this matter checked, and supply any information which may serve to clarify the schedule.

LOUIS GRABENSTEDER

Mr. Whitehouse's Reply

When I first received and read Mr. Grabensteder's letter I thought I had left myself wide open for something. However, I think I can explain the confusion so that it will be clear.

If Mr. Grabensteder will give the arrangement a little more study I am sure it will be clear to him. Perhaps it will be easier to understand if one thinks of the day ending at 8:00 A. M. instead of at 12:00 midnight.

The point in question is the D shift on week end relief. This crew works from 4:00 P. M. to 12:00 midnight on the Sunday of July 18, relieving the B shift. Then they are off 24 hr and start at 12:00 midnight Monday and work to 8:00 A. M. Tuesday, relieving the C shift. They are then off until 8:00 A. M. Wednesday, their day off.

The C shift is off each week three separate periods of 24 hr, one of which is considered their regular day off. The other shifts are off 40 hr between the time they leave work and the time they return on their regular off day.

Some may be of the opinion that the D shift is at a disadvantage by being off only 24 hr and calling it a day off. However, my experience has been to have men on the D shift request to be placed there steady. So I don't think it is as disagreeable as one might think.

When we think of the day ending at 8:00 A. M. we must bear in mind that for a man to receive credit for working any day he must put in his regular time between 8:00 A. M. and 8:00 A. M. If he does not he naturally does not receive credit for the day and is considered off on any such day.

B. H. WHITEHOUSE

JULY 1943

Day & Date	Day 1 Shift A	PM 2 Shift B	AM 3 Shift C	4 Relief D
Mon. 12	AM-8:00-4.00	PM-4:00-12:00	Off	AM-12:00-8:00
Tue. 13	8:00-4:00	4:00-12:00	AM-12:00-8:00	Off
Wed. 14	8:00-4:00	4:00-12:00	12:00-8:00	AM-8:00 4:00
Thu. 15				
Fri. 16				
Sat. 17	Off			
Sun. 18		Off	12:00-8:00	PM-4:00-12 00
Mon. 19			Off	AM-12:00-8:00
Tue. 20				Off
Wed. 21	8:00-4:00	4:00-12:00	12:00-8:00	AM-8:00-4:00
Thu. 22				
Fri. 23				
Sat. 24	Off			
Sun. 25	8:00-4:00	Off	12:00-8:00	PM-4:00 12:00
Mon. 26	8:00-4:00	Off	12:00-8:00	PM-4:00-12 00
Tue. 27	8:00-4:00	4:00-12:00	Off	AM-12:00-8 00
Wed. 28	PM-4:00-12:00	AM-12:00-8:00	AM-8:00-4:00	Off
Thu. 29				AM-8:00-4:00
Fri. 30				
Sat. 31				
Sun. 1	Off	12:00-8:00	PM-4:00-12:00	AM-8:00-4.00
Mon. 2	4:00-12:00	Off	AM-12:00-8:00	AM-8:00 4 00
Tue. 3	4:00-12:00	12:00-8:00	Off	8:00-4:00
Wed. 4	4:00-12:00	12:00-8:00	AM-8:00-4:00	8:00-4:00
Thu. 5				
Fri. 6				
Sat. 7				Off
Sun. 8	Off	12:00-8:00	PM-4:00-12 00	8:00-4:00
	2	3	4 Relief	1

Work Schedule reprinted from October issue

SIMPLICITY OF DESIGN MEANS EASIER MAINTENANCE . . .

LENDING A HAND *to the* MAINTENANCE MAN

• He can use plenty of help these days . . . his job of keeping the machinery of production going takes all he can give it. And among his most vital needs are valves that won't take a lot of costly time out for repairs . . . valves that he can depend upon for uninterrupted performance.

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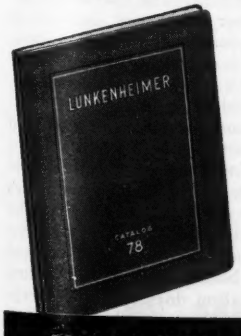

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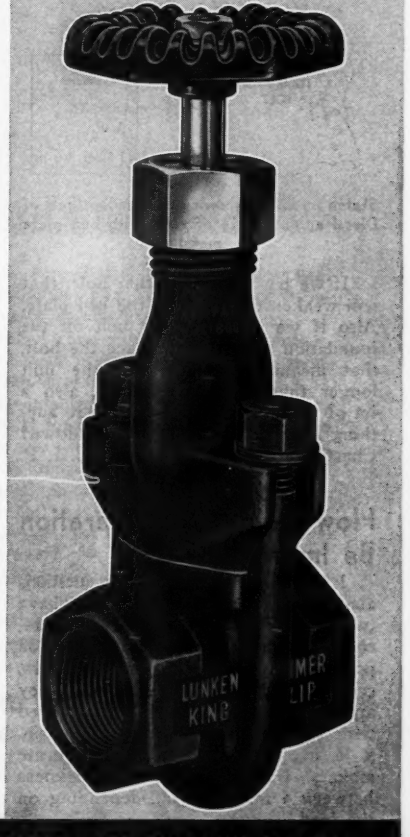
YOU CAN TAKE IT APART IN A JIFFY . . . . . .

Simply unscrew two nuts at top of clip and entire bonnet-stem-disc assembly can be lifted from the body with complete accessibility for inspection.



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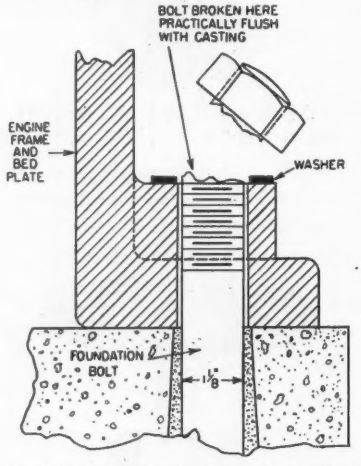
Questions And Answers

Question No. 247

What Would You Do with This Broken Anchor Bolt?

IN TIGHTENING down the anchor or holding-down bolts on one of our two Diesel engines, one of them broke off even with the top of the engine bed plate as shown in the attached sketch. What can you suggest as the best way to remedy this trouble?



Sketch by C. I. P. showing how anchor bolt of Diesel engine broke off flush with bed plate metal

If we try to drill another hole, that will weaken the metal of the bed plate. Also if we lift the entire unit off the foundation and try to replace the bolt, that means shutting down the unit longer than we can spare it, also a lot of work re-aligning it. Is there anything I can do to avoid that shutdown?
Chesterton, Md. C. I. P.

Question No. 248

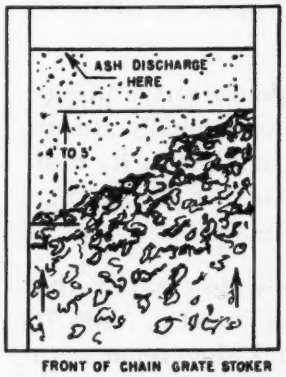
How Can Boiler Operation Be Improved?

I WOULD LIKE to ask some questions about operating my boilers. I have two B & W 4-drum, bent-tube boilers, each rated at 600 hp, operating at 135 psi steam pressure, no superheaters, economizers or air preheaters. They are about 4 years old. They are fired with Northern Illinois wash nut, 1 in. x ¼ in., on forced draft chain grate stokers. I carry the fuel bed thickness between 4 in. and 6 in., depending on the load.

A.—At present our flue gas temperature averages around 560 F, but ranges from 460 to 700 F. I have been getting 6 to 8 per cent CO_2 but when I changed the caustic potash solution (in the CO_2 recorder, we assume—Ed.) the reading improved to an average of 9 per cent. Now, shouldn't I be getting a lower flue gas temperature than that and shouldn't I be able to get higher CO_2?

B.—In one boiler, the fire burns in a V shape; that is, one side of the fire burns 4 or 5 ft shorter than the other, as shown in the accompanying sketch. What is the cause of this and how can it be remedied?

C.—On the above boilers, the 16 heads of the eight boiler drums are not insulated. Would you recommend covering these heads with asbestos, to stop the heat loss, leaving only the man-holes uncovered? I ask this question because I can't understand why the heads of these drums were not covered when they were installed to save the large amount of heat radiated.
Chicago, Ill. J. S. R.



Diagrammatic plan view showing how fire burns V-shaped on one of J. S. R.'s chain grates

Question No. 249

Why Did Slag Screen Tubes Fail in Only One Boiler?

OUR TWO STEAM BOILERS, of the Stirling 4-drum type, are connected in parallel to the steam header and are fed from the same boiler feed pump. The boilers are rated at 931 hp each. The feedwater enters at 215 F. The steam pressure is 245 psi, superheat 100 to 120 F.

Each boiler had been on the line about thirty days after cleaning, when two of the slag screen tubes in one boiler failed by rupture. The tubes were replaced, the boiler cleaned and put back on the line. In three weeks, failure again occurred in the same boiler, this time by the loss of nine tubes. Each tube had from one to six bags all on the under side (next to the fire).

The boilers were and had been for some time making about 58,000 lb steam per hr each.

The two tubes installed after the first failure were among the nine failing three weeks later. A chalky scale showed in the tubes that failed. The scale ranged in thickness from 1/64 in. to 1/16 in. Treatment was maintained within the prescribed limits.

I would like to have comments of readers on these tube failures, and on the fact that the other boiler was not affected, after having been on line about fifty days since the last cleaning and apparently in good condition.
Boldman, Ky. T. E. H.

Question No. 250

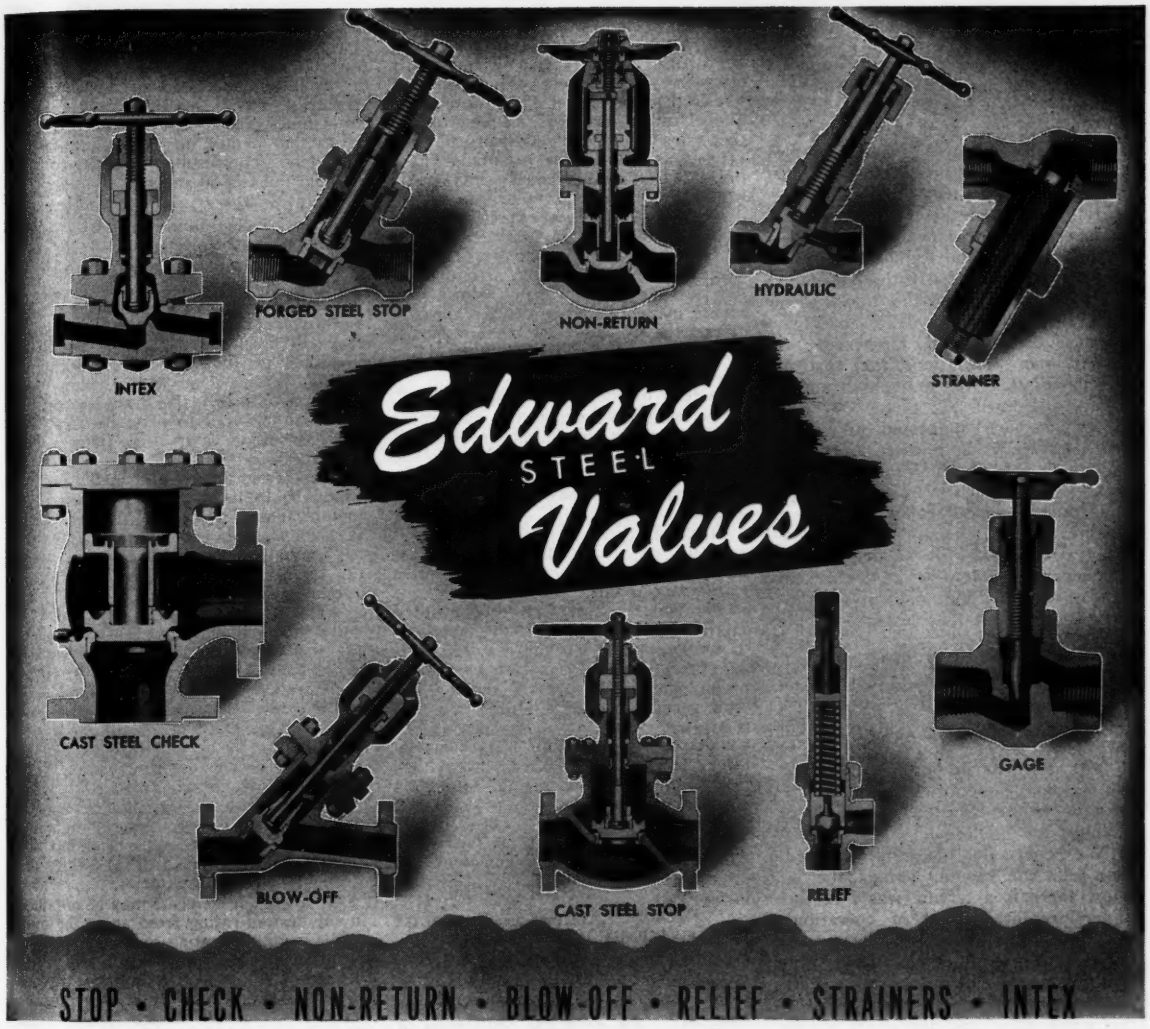
How Stop Fuel Waste in This Unit Heater System?

IN A LOCAL industrial plant, they are experiencing difficulty in returning the condensation from the heating plant to the boilers. We have already suggested several things to them but should like further suggestions for the proper solution from readers, bearing in mind the present difficulty in obtaining materials and the cost involved in making suggested improvements.

The boiler room is equipped with: two new 250 hp high-pressure steel boilers, stoker fired; two steam-driven vacuum return pumps; one preheating tank mounted above the vacuum pumps and vented to the atmosphere; two steam-driven boiler feed pumps. The returns from the plant come back to the vacuum pumps and the condensate is pumped to the preheating tank, thence to the boiler feed pumps and into the boilers.

They carry 75 to 100 psi steam pressure on the boilers and feed this steam under these pressures to the heating load in the plant, which consists mainly of unit heaters. The heaters and main ends are all equipped with high-pressure bucket traps. The radiation load on the boilers is approximately 65,000 sq ft. They do not use the high-pressure steam for processing—only for operating the vacuum pumps and boiler feed pumps. The operating engineer, however, does not approve of placing the heating load on low pressure, as he is of the opinion that the plant cannot be heated on low pressure.

The problem is this: The condensate comes back to the vacuum pumps so hot that the pumps cannot handle it. Consequently they feed cold city water by hand into the return lines to cool the condensate so that the pumps can discharge it to the preheating tank and thence to boiler feed pumps and boilers. As a result, when the condensation does cool and everything is operating properly, the boilers become flooded and it is necessary to blow them down frequently, resulting in a terrific waste of fuel.



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We have suggested several possible methods of correcting this difficulty. First of all, we appreciate that some or many of the traps may be blowing through.

We have suggested the installation of flash tanks to flash steam from the condensate to the atmosphere or to utilize the flash steam for additional heating. This method the operating engineer did not approve. We also suggested the installation of heat exchangers, properly fed with cold water and automatically and thermostatically controlled. This method the operating engineer did approve. However, due to the many elevations, the cost of this installation was quite high and it was turned down.

It has been suggested now that pump governors and water level controllers be installed. We do not feel that these controls will correct any of their difficulties except to maintain a definite water level in the boilers. They will still have the problem of hot condensate which the pump cannot handle and which, if controls are installed, will have to be wasted to the sewer.

We have also suggested the installation of pressure reducing valves on the mains in the boiler room to reduce the heating load to low pressure but leave the boilers on high pressure to feed steam to the pumps. However, as previously stated the operating engineer does not like low pressure for heating.

We believe this hot condensate will soon ruin the vacuum pumps and we know there is a terrific waste of fuel under present method of operations. We understand there is a vacuum or condensation pump on the market now that will handle hot condensation without damage. If you know the name of this pump we should appreciate having this information.

We should like to know whether you approve of any of our methods of handling this problem and if not, we should appreciate hearing from you with a better solution.

Elkhart, Ind. H. E. S.

Question No. 251

Would 220-v Motor Be Harmed by Connecting to 110-v Circuit?

WHAT HARM would result to a single-phase alternating-current motor, designed for operation on 220 v, if it were connected to operate on a 110 v circuit?

Chicago, Ill. E. S.

Answer No. 222

How Prevent Fuses From Blowing?

ALL HIS FUSES are 220 v and 30 amp clear back to and including the main board. But an overload will blow these, shutting down everything, said A. H. P. in the April issue. Could he put two 30-amp links in each main board fuse? If so, how much would it increase amperage?

There was so much interest in this question when it was published that we decided to arrange for a formal article by a fuse authority that would really cover the whole subject. This has taken longer than we expected, for he is busy, like all other engineers, helping to win the war. But, don't despair—the article's coming. In the meantime Question No. 244, in the January issue, again emphasizes how important it is to understand fuses, so we are publishing more of the answers to No. 222.

Everybody who has answered so far agrees there's something wrong with A. H. P.'s whole set-up. Fuse and wiring methods and details are given to correct the trouble. One engineer points out that he will gain little by doubling his 30-amp links.

Consider Wire Sizes and Starting Current

IN REGARD to your question concerning 30-amp fuses, it should not do any harm to put in two 30-amp fuse links on the main panel as the individual motor circuit on each motor has 30-amp fuse protection.

This, of course, is true if your carrying wire has a high enough carrying capacity to where it branches off to the individual circuits.

To find the fuse capacity permitted for circuit protection, find amperage of the motor that has the heaviest starting current and the actual ampere rating of all other motors on the feeder. The code permits use of a still larger size if two or more motors must be started simultaneously, providing proportionately larger feeders are installed. From this, two 30-amp fuse links should not be too large since each motor circuit has 30-amp protection fuse links.

Answer to second part of question—This should increase the amperage approximately twice that of one fuse link in use.

RAYMOND G. SUNDQUIST

Westwood, Calif.

Something Wrong with Either Fuses or Wiring

THERE is something definitely wrong with either the electrical installation or fusing of the circuits. A. H. P. states his fuses clear back to and including the main board are 220 v, 30 amp.

On the surface, according to his overcurrent protection, namely 30 amp, the size conductor required to carry this current would be No. 8. Now then, if this installation were made using No. 8 wire for feeders from the main board and also for the branch circuits, the wiring is wrong.

To remedy this condition, larger feeders should be installed and fused accordingly. To calculate the proper size of feeders supplying several motors, feeders shall have a current carrying capacity of not less than 125 per cent of the full load current rating of the highest rated motor in the group plus the sum of the full load current ratings of the remainder of the motors in the group. (National Electric Code Article 430, Section 4314.)

If A. H. P.'s fuses are not of the proper capacity he can easily check by determining the size of the conductor the fuses protect. If they are larger than No. 8, by consulting a current-carrying capacity table he can find the proper size fuse to install. By using the above method of calculating feeder size, he can determine if the feeders will carry the connected load.

To further protect feeders, branch circuits and motors, A. H. P. can install thermal overload protection on each individual motor.

Installing two 30-amp links where normally one is used is bad practice. Sometimes, this is done in cases of emergency but should not be tolerated indefinitely. The resulting capacity of two 30 amp links is 60 amp.

Detroit, Mich. CASPER E. HACKEM

Use Proper Protective Devices, Details Herewith

AS THE MOTORS are individually protected by the same size of fuse, I believe it would be a good policy to increase the size of the renewable fuses to, say, 35 amp. In this way the motors would be protected as they should be with the 30-amp fuses. Then with 35-amp fuses on the main board, if for any reason the motor should fail to blow its fuse, the board would have its fuses blown with an overload.

Another means to protect the motors would be to have what is known as a motor-running protective device. Most of these devices make use of a "heater coil" usually consisting of a few turns of high-resistance metal, though the heater may be of another form.

One type of construction, which is quite commonly employed in controllers for small motors, makes use of a shaft to which is soldered a ratchet wheel or equivalent device. When the contactor is closed to start the motor, the shaft is caused to rotate against the action of a spring and is held in this position by a pawl which engages the ratchet. The heater coil, which carries the motor current, surrounds the shaft and, if excess current is drawn by the motor, the shaft is heated until the solder holding the ratchet wheel is melted, allowing the spring to open the contactor.

These heater elements may be obtained in any desired rating from about 0.5 amp to the maximum rating of the starter, the rating being the current which will cause the switch to open. Another type of construction makes use of a thermostatic strip or "bimetal" which bends when heated, releasing a catch and allowing a spring to open the contactor. The "bimetal" is usually heated by current passing through the strip itself.

The type I've always favored are the fuses known as "fusetrons" and are available in ratings up to 600 amp at 250 v or 600 v, and cartridge-type "thermatrips" are made in ratings up to 100 amp at 250 v. These devices are time-delay fuses having the same general characteristics as the plug type of fuse.

For example, to provide both branch-circuit protection and motor-running protection for a 15-hp, 220-v three-phase motor having a full-load current of 38 amp, for ordinary service a fusetron or thermatrip rated at 40 amp would be used. Either of these fuses has sufficient time lag so that it will not blow on the starting current of the motor, but will blow on a 125 per cent overload in about two hours, this being in accordance with the standards of Underwriters' Laboratories for motor-running protective devices.

So my advice to A.H.P. is to control the motor or rather protect it better than the way he now has it. Because if he has six motors on the line and two of these should take more of the load than they should, for any reason, then the motor fuses on these machines would go, which would leave the other four machines running

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and not hold up work that these machines are doing. If each motor has a different piece of work to do, just think of how many units the arrangement now holds up (rather the time lost). If the motors are individually protected, a better check-up can be made on the one or more motors and the knowledge of why it is happening.
Philadelphia, Pa. WILLIAM T. MULLEN

Motors and Feeders Determine Fuses, Deichmann Says

YOU STATE that all your 220 v. motors are individually protected by 30-amp. fuses. A 30-amp. fuse will carry a 3 hp. motor and if you apparently added any motors to this 30-amp. line, this will automatically act as a feeder if you check up on your motors and put in the proper fuse according to the horsepower of the motor.

Check up the size of wire or feeder coming from the main switchboard and fuse your line according to the size of the wire or feeder, also check up for loose wires and weak fuse clips. These will not only blow fuses out but will scorch them also. Your motors are overprotected with a 30-amp. fuse if they are less than 3 hp. and your line is properly protected at 30 amp. If you put in two 30-amp. links into a single cartridge fuse your line is carrying double the load. This will overload your line and probably cause fire.

Here is a table to guide you:

Horsepower	Wire	Fuse Protection on Line
1	No. 14	15 amp.
2	No. 14	20 amp.
3	No. 14	30 amp.
5	No. 12	45 amp.
7½	No. 8	70 amp.
10	No. 8	80 amp.

If you stated what load you are carrying in horsepower, I could answer your question more definitely. When a line is put in for a certain motor and you add one or two extra motors, you are overloading the fuse and if you put in a larger fuse or two links in each fuse you are overloading the line. If you study over my table I think you will find out why.
New Orleans, La. GEORGE DEICHMANN

Two Links Would Increase Capacity Very Little, Says Schoenig

IN THE APRIL issue A.H.P. asks about putting more than one 30-amp fuse link in a 30-amp renewable fuse cartridge. The greatest harm will be a decided increase in cost.

The terminals of a 30-amp fuse cartridge are designed to properly care for a 30-amp load more or less indefinitely to dissipate the heat acquired, and to provide proper contact area with the fuse holder.

If the fuse blows due to a sustained overload, which is apparent as it is on the main line, the fuse link merely separates because of the increased temperature of the terminals. This temperature will be approximately the same whether one link is used or more than one.

To use two 30-amp links in place of one in this situation would retard the blowing only a very little, therefore there could be only a relatively small increase in the carrying capacity of the fuse. The result would be more heat at the terminals, poorer contact surfaces, and charred fuse bodies which lead to breakage or early replacement.

The layout described by A.H.P. is a very poor one. In ordinary practice the copper and fuses in the main line should be large enough to carry one-half the total connected load, plus the ampere rating of the largest motor.
Clinton, Ia. L. R. SCHOENIG

Answer No. 240

Comments Wanted on This Oil-to-Stoker Conversion

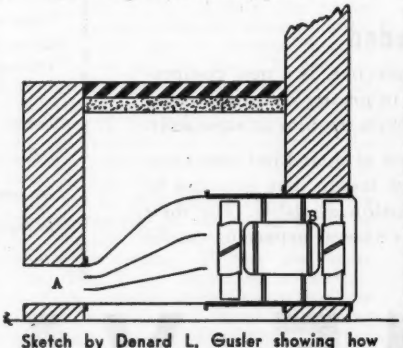
IN THE NOVEMBER issue, R. W. presented a sketch of the method proposed to convert an oil-fired 600-hp longitudinal drum boiler, with two drums and set in battery, to coal firing with a twin-retort underfeed stoker. One feature of the proposed scheme was a motor-driven forced draft blower, set in the space just behind the budge wall, under the rear of the boiler and inside the rear boiler wall. This was done, said R. W., because of lack of space around the boiler but he didn't feel it was a good place for a motor-driven fan and disapproved the idea. He asked for comments on this and other features. In the January issue, Martin Gozdenovich suggested a way to get the fan motor out where it would have better operating conditions and G. G. Nash suggested eliminating the motor trouble by using a turbine-driven blower. Here is another comment that has just come in.

Axial Blower Would Cool Itself, Gusler Suggests

SINCE R. W.'s boiler is one of a battery, entrance to the furnace is probably possible only from the front or back of the boiler setting. Apparently it is too crowded at the rear of the boiler to permit installation of the usual type of force draft fan but there is room for necessary maintenance.

If such is the case, then R. W. might solve his difficulty by installing a single or two stage axial blower as indicated in the accompanying sketch. One large or two small blowers could be used, depending on the size of the openings in the front of the boiler through which the fans would have to be removed for replacement or repair.

Incoming air, traveling past the motor through the ducts, would provide the necessary cooling medium. The motor bearing could be greased through piping extending through to the rear of the boiler. Periodic inspection of the fan could be made by removing the air intake screen at the rear of the boiler. The air volume could be regulated with a conventional damper at A or regulating radial vanes at B.



Sketch by Denard L. Gusler showing how axial blower could be installed to get forced draft fan out of space under boiler

The possibility of effective use of overfire air should be considered, for this would reduce the size of the forced draft fan.
Morgantown, W. Va. DENARD L. GUSLER

Answer No. 243

How Improve Draft with This Chimney?

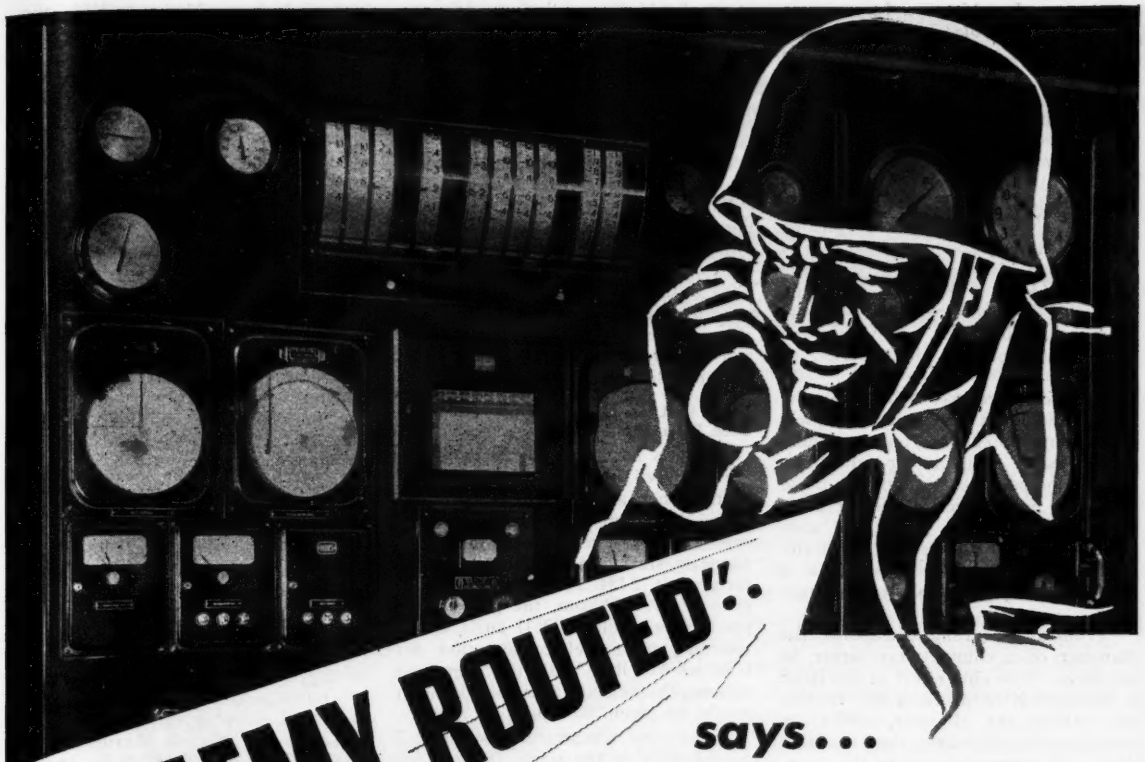
HE COULD GET ONLY 0.08 in. of draft on his boiler, said C.E.D. in the December issue, with a stack 35 in. by 35 in. in area at the top and 50 ft high above the grates. His smoke pipe where it enters the stack was 18 in. in diameter. He wanted to know if the difference in size of smoke pipe and chimney caused the low draft or if it were a downdraft of some kind. Also he wanted to know if the draft could be increased by adding 8 or 10 ft of 18-in. diam pipe to the top of the stack.

Chimney diameter can't be too big, says J. G. Mingle, and another 20 ft of height would improve draft and save coal

IT IS IMPOSSIBLE to properly analyze C.E.D.'s troubles in How Improve Draft With This Chimney in your Dec. 1943 issue for the reason that the quantity of gases which the chimney handles is not given. Also the location of the point where the draft observation of 0.08 in. of water was made is indefinite. It is quite uncertain where "on the boiler" might be.

The value of 0.342 in. of water which you obtained from the formula is the maximum theoretical draft, or more properly, the shut-off draft, and has no bearing on the problem except to locate this point on the draft-capacity characteristic. If the quantity of gases handled by the chimney were known, then the draft loss due to friction in the chimney could be calculated and the available draft of the chimney easily determined. A comparison between the draft loss throughout the system and the draft-capacity curve of the chimney would instantly locate his trouble.

Your theory that the low draft is due to the low velocity of the chimney gases which allows the gas temperature to drop "rapidly" because of the relatively long time the gases are in the chimney is not the answer to the problem. If the chimney is overloaded, that is, handling too large a quantity of gases, the gas velocity would be high—at least 30 ft per sec. In this case, a layer of gases would require less than 2 sec to pass up the chimney. On the other hand, if the gas quantity is low, the velocity would be 10 to 15 ft per sec, for example, and a layer of gases would require from 3 to 5 sec



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to pass up the chimney. In any reasonably imaginable case, the gases would require only from 2 to 5 sec to pass up the chimney.

It is difficult to imagine an appreciable temperature drop within these intervals, especially in a square brick chimney where the walls of the structure are at least 8 in. thick at the top and from 12 to 16 in. at the bottom. After a chimney has been "warmed up" and in use for several hours, it is questionable whether more than a little heat would be transferred from the gases to the chimney walls, for the reason that the gases are within the chimney for only a short period of time.

All this, of course, is based on the presumption that the walls are thick, as they undoubtedly are, and that there are no leaks. Only in air-tight brick and reinforced concrete chimneys could there be no appreciable temperature drop of the flowing gases. In steel stacks, lined or unlined, and in any chimney that has air leaks, there is of course an appreciable temperature drop.

From an operating standpoint, the diameter of a chimney can never be too large. The only effect of too large a diameter is to decrease the friction loss within the chimney, which, in turn, would increase the available draft. If every chimney in the country could now be increased 1 ft in diameter, it is a safe guess that a multitude of boiler plant operating troubles would be eliminated.

The suggestion that the abrupt enlargement from the 18-in. smoke pipe of the approximately 35-in. square chimney would cause an appreciable draft loss has little merit, for with a nominal gas flow for a chimney of this size, the draft loss would not amount to more than 0.005 in. of water.

All the arguments presented above are based in a nominal gas flow for a chimney of this size. A long range viewpoint of C.E.D.'s troubles would indicate that the 50-ft chimney is being overloaded, and therefore the chimney is not of sufficient height. An addition of say 20 ft to the present chimney would increase the available draft at any point on the draft-capacity curve 0.137 in. of water. All other conditions being equal, the draft on the boiler would then be increased to 0.217 in. of water.

The addition of 20 ft to the top of what apparently is a common brick chimney with an 8-in. wall at the top of the structure would involve no construction difficulties and, moreover, would not decrease the safety factor of the structure appreciably.

It is possible of course, as with any installation, to make a series of changes in the present arrangement which would decrease various losses of draft in the system head and increase the available draft of the chimney appreciably. But in the end it will involve less cost and trouble and insure more draft by adding to the present height of the chimney.

It should be noted that adding to the height of an existing chimney not only increases the available draft but also the capacity of a chimney.

There are hundreds, possibly thousands, of installations similar to C.E.D.'s throughout the country in which draft troubles are encountered. In many of these, the lack of sufficient chimney draft may be made up by adding to the height of the chimney. This procedure is relatively low in cost, requires no critical materials, can be done within a reasonable time by an experienced contractor and, most of all, will increase combustion efficiency and thereby SAVE COAL.

Indianapolis, Ind. J. G. MINGLE

Check for Leakage and Diagram Performance, Clark Suggests

IF IT IS ASSUMED that 20 lb of gas are produced from each pound of coal burned, then at 535 F the gas volume would be about 500 cu ft per lb of coal burned. The area of the 20-in. diameter stack specified by the manufacturer is 2.181 sq ft. With a gas velocity of 1200 fpm, the gas volume per minute would be 2617 cu ft, corresponding to a fuel consumption per hour of 314 lb. With the same gas volume, the velocity at the stack outlet would be about 308 fpm.

Since the temperature would fall considerably in the stack, the average velocity would be less than one-fourth of the usual design values. Actual operating rates would vary with the rate of fuel burning, and would no doubt be less than the values assumed.

A similar condition is reached in nearly all industrial plants during week-end and other shut down periods when steam production falls below 25 per cent of the normal operating output.

For a given installation and rate of operation, the actual draft is a function only of difference in stack and outdoor temperatures. Mean stack temperatures will depend on materials of construction, which determine radiation losses, and on condition of repair, which affects leakage losses. Since the material is probably brick, it can be assumed to be fairly effectively insulated. On this basis, the lack of draft can be due to infiltration of air, which reduces gas temperature and increases friction losses or to restrictions in the ducts adding to friction losses.

It is suggested that C.E.D. check the draft under a steady load at the base of stack, at the 18-in. inlet to the stack, at the boiler outlet and above the fuel bed in the furnace. Several sets of readings should be taken, at various loads ranging from banked fire to maximum output. If these readings are plotted as shown on the accompanying graph, actual performance will be clearly illustrated. If possible, temperature readings at each point, taken at the same time as draft readings, will assist in locating faults.

Under normal conditions and depending on plant design, the draft loss through grate and fuel bed runs from 50 to 75 per cent of total draft. Also 15 to 35 per cent of total draft is normally lost in the boiler passes and ducts to stack. The actual loss in the stack itself is usually a very small percentage of the total. Leakage into the system may occur at the stack, at the base of the stack cleanout, at the breeching connection, or at the brick setting.

(Editor's Note—For method of testing for leakage at these points see A Candle is an Effective Instrument, Letters & Comments, P. E. & E., January 1944 issue, page 92.)

The friction loss will be reduced by any increase in duct size or by any change of duct shape that will reduce sharpness of bends and section changes. Increasing the stack height as suggested will increase draft but leakage and friction values should be carefully checked first.

Losses due to friction and leakage should be brought to the lowest possible level regardless of whether or not an increase in stack height is ultimately necessary. C.E.D. can calculate actual duct velocities if he determines rates of fuel fired, gas analyses, and gas temperatures for various operating conditions. Gas velocities should normally not exceed 600 fpm in breechings, with 1200 fpm as the absolute maximum.

St. John, N. B., Canada. C. G. CLARK

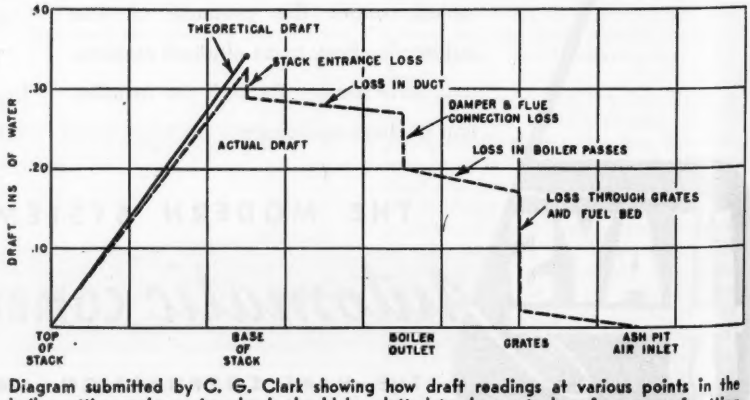

Diagram submitted by C. G. Clark showing how draft readings at various points in the boiler setting under various loads should be plotted to show actual performance of setting and stack

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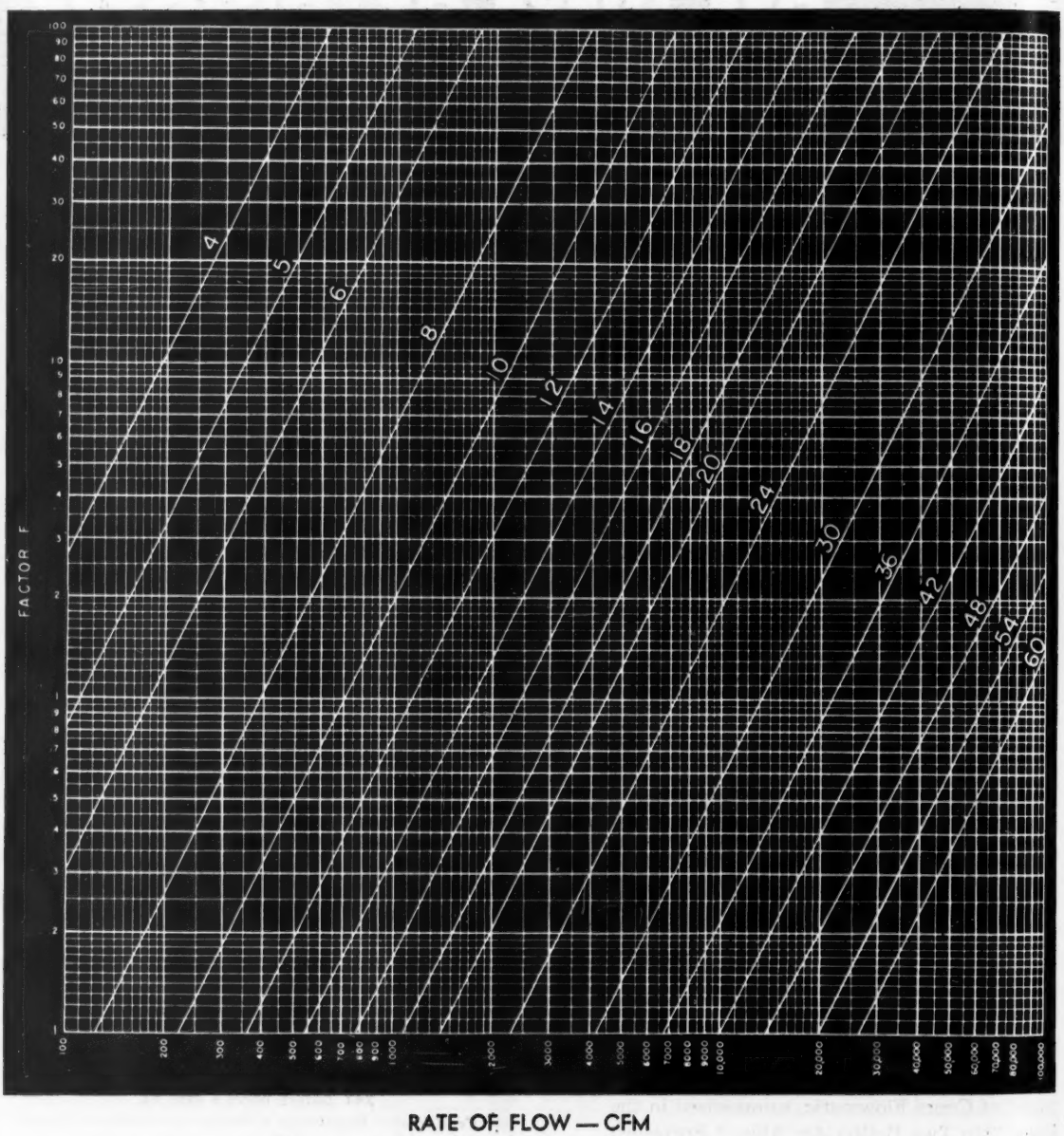
CHART FOR CALCULATING LOSS OF PRESSURE DUE TO PIPE FRICTION FOR AIR OR GAS

(Presented by courtesy, De Laval Steam Turbine Co.)



RATE OF FLOW — CFM

Measured at standard conditions at 14.7 psi, Abs and 60 F

$$P = \frac{F}{Pm} \times \frac{L}{1000} \times \frac{T}{520} \times G$$

P = Pressure drop in pipe line (psi)
F = Friction factor from chart above
L = Length of pipe (feet)
Pm = Average pressure in pipe (psi, Abs)
T = Flowing temperature (Abs in deg F)
G = Relative specific gravity of gas (air = 1)

PRODUCTION INCREASED AND... COSTS CUT

Here is the case of a large mid-western steel company that not only increased production, but also cut costs through the services of W. H. & L. D. BETZ. Generating over 10,000,000 pounds of steam per day, this plant was troubled with a severe carryover condition resulting in serious turbine blade deposits. Betz engineers were called in on the job. With special test equipment and with the necessary engineering know-how the trouble was quickly diagnosed and recommendations were made which completely solved the problem.

But Betz engineers did not stop here. Further investigations revealed numerous other phases of water conditioning needing improvement. For example, the coagulant used in the cold lime-soda softener was changed with resulting savings. The internal treatment of the boiler water was revised and an entirely different control established which effected fuel savings of $900.00 monthly through decreased blowdown.

Total savings resulting from these recommendations amounted to over $1500.00 per month. But the most important result of the study, difficult to translate into dollar savings, was the elimination of production losses due to outages caused by improper water conditioning.

This is a true example of the services rendered to industry by W. H. & L. D. BETZ. It is typical of hundreds of others in our files. It illustrates how a sound engineering approach is always applied to each problem and recommendations are individualized for each case.

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BETZ

The Gas Turbine—An Engineering Dream for 150 Years

(*Continued from Page* 90)

brary, which gives early proposals of some details.

The author participated during 1898-1899 in the actual operation on the "Big 4" railway tracks between Columbus, Ohio, and Indianapolis, Ind., and later on the Pennsylvania Railroad tracks between Chester and Darby, Pa., of full-sized railway passenger cars, self-propelled by gasoline engines, using the "variable-speed" transmission of the Reeves Pulley Co. of Columbus, Ind. This probably was the predecessor of all modern internal-combustion locomotives. Plans were formulated in 1898 for replacing the gasoline engine by a gas turbine, as was set forth in the Master's thesis cited. This is the earliest proposal that the author knows of for a gas-turbine locomotive. But the proposition never came to a head.

First Gas Turbine Patent in 1791

During the planning for this proposed gas-turbine locomotive, patent searches were made, and unexpectedly there was found a British patent on November 30, 1791, to John Barber, giving probably for the first time, the fundamental gas-turbine plan.

An early diagram of Barber's cycle is given in Fig. 1, from the thesis mentioned. Many gas turbines proposed since differ in plan only by the addition of a heat interchanger for transferring the heat of the exhaust gases to the compressed air proceeding to the combustion chamber. An early mention of this is in the Doctor's thesis, and an experimental model was constructed in 1905. It is not probable that the apparatus shown in Barber's British patent ever was operated.

Fig. 2. Combustion chamber of General Electric gas-turbine research 1903

Davey lists some partial approaches to the gas turbine and gives a list of British patents beginning in 1856. The earliest complete United States gas-turbine patent of which the author has personal knowledge is to Charles G. Curtis, June 24, 1895. Mr. Curtis had extensive connections with regard to steam turbines with the General Electric Co. The author has some knowledge of these, but none of any actual work on gas turbines by Mr. Curtis.

At this same time was a United States Patent to Leon LePontois filed December 5, 1895, on an explosion combustion chamber for a gas turbine. Actual tests were made of LePontois' explosion apparatus, as well as a theoretical study, with unfavorable conclusions.

United States Gas-Turbine Research

The author always has had in mind continuous combustion, and after the gas-turbine-locomotive scheme, proposed in 1898, came to naught, he started gas-turbine research in 1901 in the Sibley College Laboratory, Cornell University. Laboratory time for a year was required to get a continuous-combustion chamber in stable operation. It frequently went out and then the oil on the red-hot firebrick lining filled the neighborhood with dense black smoke, so the Sibley College people well knew of the gas-turbine research.

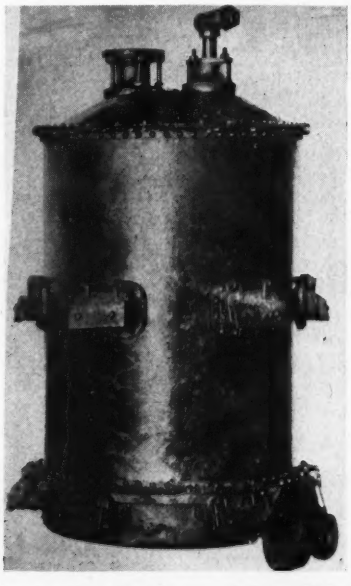


Fig. 3. Heat interchanger of General Electric gas-turbine research 1905. Air from compressor passed through tubular coils in shell, exhaust gas from turbine circulating ouside coils

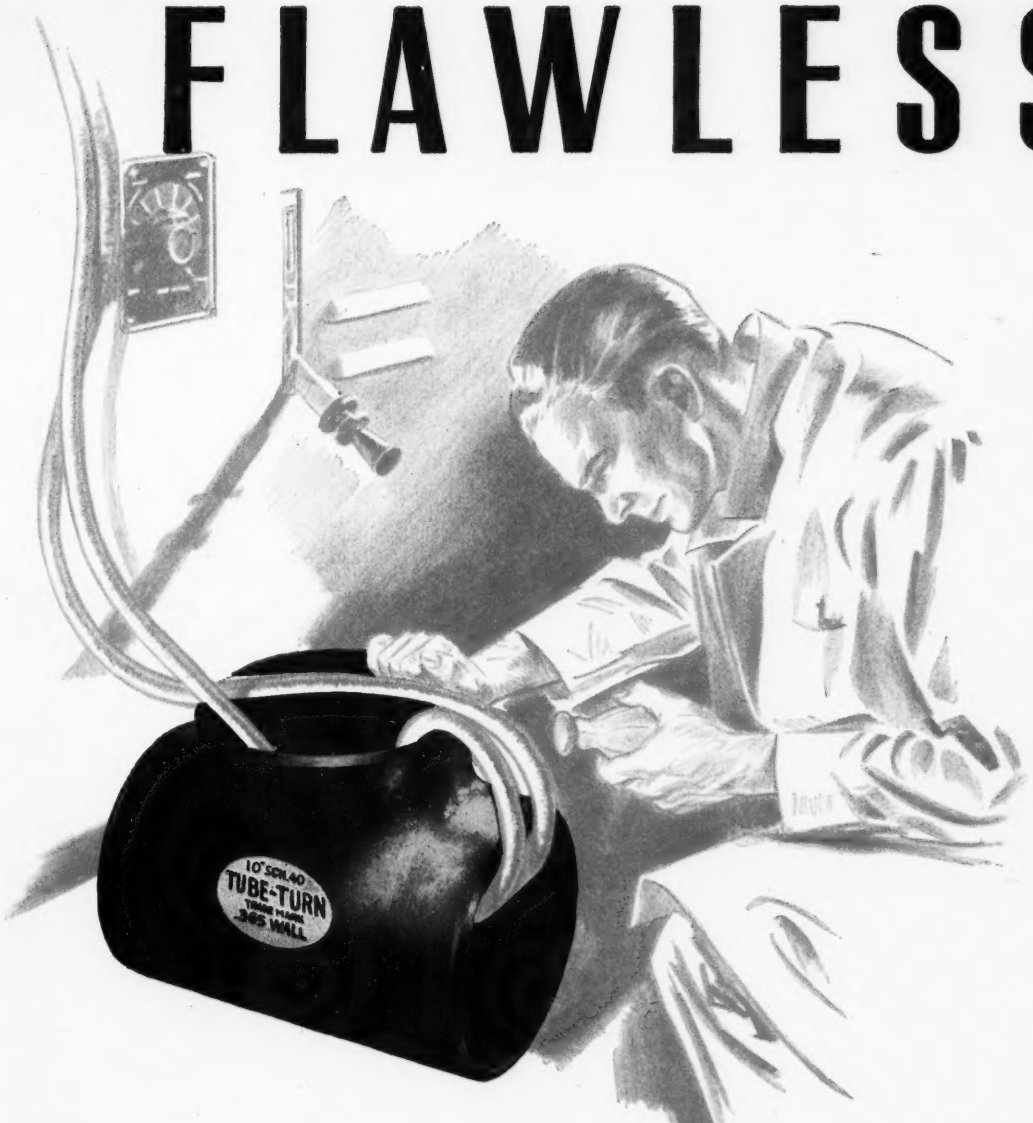
The first De Laval steam turbine in the United States, which had been exhibited at the World's Fair in Chicago in 1893, was used for the De Laval nozzle-patent demonstration mentioned later on and then went to Cornell. So the bucket wheel of this turbine was borrowed and operated with the combustion chamber, about the end of 1902. This probably was the first turbine wheel actually operated by products of combustion in the United States, and possibly was the first such turbine wheel ever operated. The entire power was absorbed by a Prony brake and the air for compression was furnished by a steam compressor, with computation of the power required.

But, as with many other experimental gas turbines, the power for compression was more than the turbine power. So, except for the historical fact that the combustion chamber actually operated the turbine wheel, the experiment was a flat failure. A Doctor's thesis was prepared and presented to Charles P. Steinmetz and Ernest J. Berg of the General Electric Co. The author previously had been a draftsman on steam-turbine work with General Electric. In June, 1903, the connection was resumed and has continued ever since, with work on various items more or less connected with gas turbines.

Fig. 4. Nozzle jet of General Electric gas-turbine research, 1905. White-hot nodes appeared in jet of products of combustion, being of one type when mouth of convergent-divergent nozzle was too small for pressure ratio, of another type when it was too large. Nodes disappeared when nozzle mouth was about the right size. Similar nodes have since been observed in the operation of steam nozzles

A number of General Electric models of gas turbines successively were gotten into operation, first at Schenectady, and beginning in 1904 at Lynn, with consultation with Prof. Elihu Thomson and Richard H. Rice. There were combustion chamber, heat interchanger, nozzle, and single-stage impulse turbine wheel; but with power for compression from an independent air compressor and allowed for by computations. Some U. S. patents were obtained during this research. Figures 2, 3 and 4, respectively, show the combustion chamber, heat interchanger, and nozzle jet

FLAWLESS



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of 1903 and 1905. The results of this research will be given later.

Foreign Gas-Turbine Research

A gas-turbine patent was applied for by Charles Lemale about 1901 and he began association with Rene Armengand in 1903 in actual operation in France of a continuous-combustion gas turbine. This probably was the earliest elaborate gas-turbine experimental work. From then on, there have been many proposals and tests of various sorts of gas turbines.

Numerous publications have been made, a few of which are given herewith. Others are in the Engineering Index Annual. Some of these operate with a hydraulic column; operate below atmospheric pressure; have cooling by water injection; have hollow turbine buckets with cooling; have cooling by air excess; use pulverized coal; use reheating combustion; or have cooled compressors. But most of these have not led to any conclusive results. The cycle now receiving the most attention is that of Fig. 1 with the addition of the heat interchanger of the previously mentioned thesis.

Carl Gustaf Patrick De Laval was building single-stage steam turbines in Sweden with steam pressures of 115 psia or so, exhausting into atmospheric pressure of about 15 psi. He said he was avoiding the disability of Napier's law by using a nozzle first convergent and then divergent, popularly called an "expanding nozzle" because of the final divergent portion. De Laval tried to get a United States patent on this shape, and the official file shows that Napier's law was cited against him, with the support of scientific experts, including Gustave Zeuner, the famous German engineer. Finally De Laval, with his 1893 Chicago World's Fair turbine gave an actual demonstration that he was right. But although the fallacies of the arguments against De Laval's idea are very evident now, and cannot be cited against the ultimate success of the gas turbine, and were partially refuted at the time, they were disturbing factors during the General Electric gas-turbine research and had to be argued against.

Compressors for Gas Turbines

In the fall of 1903, the General Electric gas-turbine research began to include development of a "centrifugal compressor," with rotative speed suitable for direct connection to the gas-turbine wheel. High-speed wheels previously had been proposed for air compression with some sort of "reversed nozzle," since called a "diffuser," for converting into pressure the absolute velocity of air leaving the wheel periphery. Such diffusers had begun to be used for incompressible fluids. They probably first had been used in 1895 in a centrifugal pump of the English scientist Osborne Reynolds.

But De Laval's plan of a turbine nozzle first convergent and then divergent, for a compressible fluid, now was firmly fixed. With this was the idea that a "reversed nozzle" for converting velocity into pressure with a compressible fluid such as air always should be the reverse of the De Laval expanding nozzle. Therefore the foregoing compressor references show such passages beyond the high-speed wheels, with the minimum section or throat of De Laval, and speak of "throat conversions of velocity into pressure." The famous French engineer, August Rateau, was working on high-speed centrifugal air compressors about this time, but the author never has been able to find out if he then used diffusers and, if so, what his early ideas were about their shape.

Nozzle Design

In a patent applied for in 1904, it was set forth correctly, probably for the first time, that with velocities below the velocity of sound, in the case of a diffuser for a compressible fluid, the velocity changes are the major items, so that passage areas change inversely as velocities, just as with incompressible fluids. But with velocities greater than the velocity of sound, the change of volume with a compressible fluid, due to change of pressure, is the major item, so that increase of velocity in a nozzle requires increase of area, and decrease of velocity in a diffuser requires decrease of area. So with a centrifugal air compressor with impeller exit velocity less than the velocity of sound, the diffuser must be divergent, just as with a centrifugal pump. But for velocities greater than the velocity of sound, the theoretical diffuser first is convergent, has a throat, and then is divergent. All of this now is elementary knowledge, but in 1904 it was not evident.

The velocities of the General Electric centrifugal compressor for the proposed gas turbine always were such as to require theoretically a divergent diffuser, and development work on this basis was begun in 1904 under the supervision of Richard H. Rice, with the collaboration of the author and other General Electric engineers. When the primary gas-turbine research ceased in 1907, the centrifugal compressor had developed so that it became a commercial product of itself.

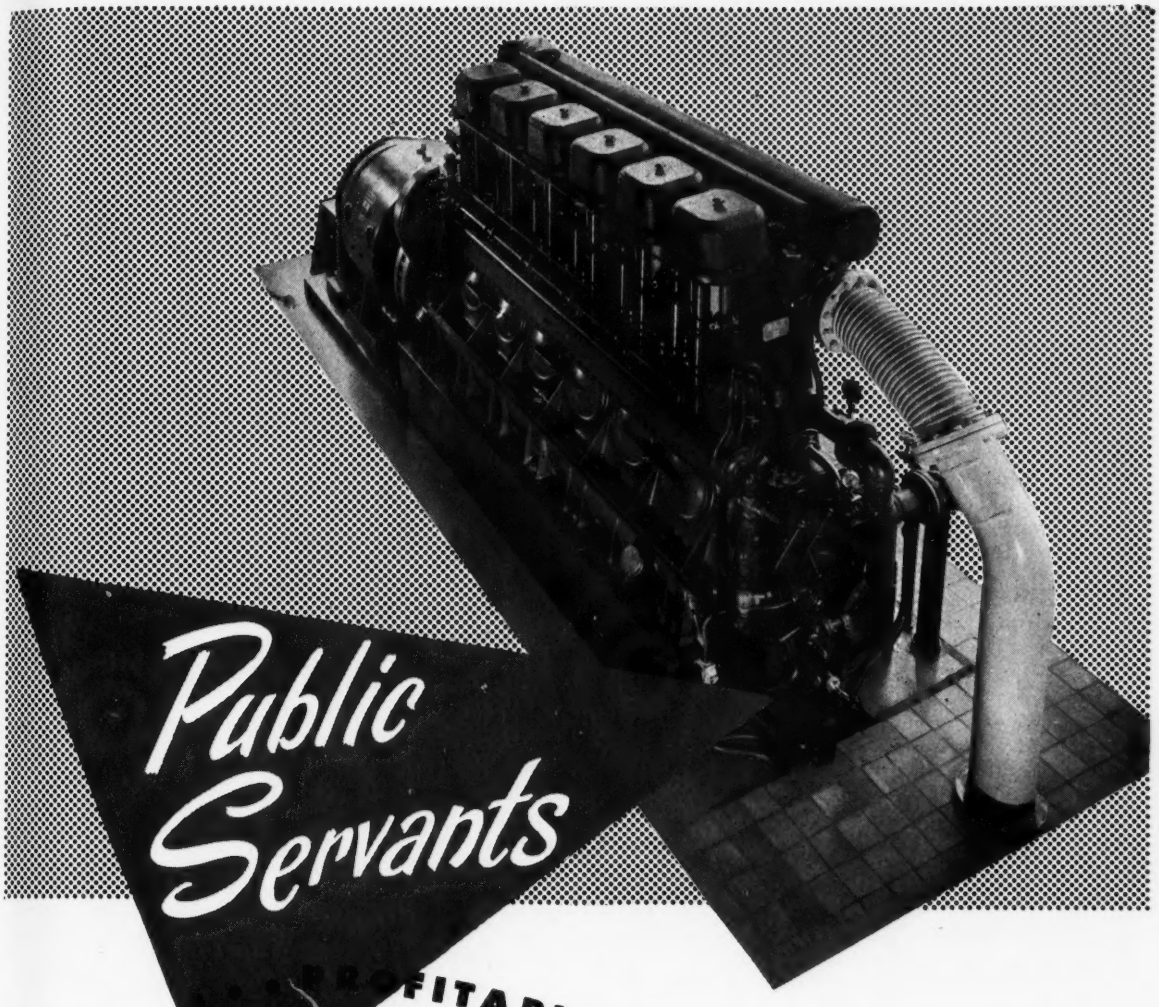
One early result was the use of centrifugal compressors for blast furnaces for production of pig iron. This met early opposition from advocates of reciprocating "blowing tubs," and it was alleged that a centrifugal compressor, operated by a flow-metering device to deliver a constant weight flow of air, nevertheless was subject to a process called "churning" whereby the impellers would rotate without delivering any air, in spite of the indication of the flow meters. This was shown to be a fallacy. Also it was shown that even though internal-combustion engines operated by blast-furnace gas might have somewhat better thermal efficiency, the small fixed and maintenance charges of the centrifugal compressor gave lower total cost of blast-furnace operation.

Rateau did some early centrifugal-compressor work, already mentioned, a great deal of it for gas turbines. Some work probably also was done elsewhere in Europe. The Ingersoll-Rand Co. has continued the development in the United States. As one result, centrifugal compressors, started in the United States as a gas-turbine by-product, now are almost exclusively used throughout the world for blast-furnace blowing, as well as in many other purposes.

Recent Compressor Developments

As another part of the General Electric development, geared centrifugal superchargers for United States aviation engines began about 1925 and now are in enormous production, using impellers based on the original Osborne Reynolds design. But in spite of the fact that some of this centrifugal-compressor development was inspired by the gas turbine, there is present evidence that the centrifugal compressor may be exceeded in efficiency by a comparatively recent competitor, the axial-flow blower. If so, this blower will be the one used in the ultimate gas turbine. These blowers are used in the Neuchatel gas-turbine power plant (34) and Swiss gas-turbine locomotive (35). But on the other hand they have a shorter operating range and many more stages than the centrifugal compressor, and progress is being made in improvement in efficiency of the latter. However, this is a matter for the future.

(To be continued)



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DIESEL ENGINES

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(*Continued from Page* 69)

to remove any accumulation of air that might be entrained in the treated water. This pump also serves as a primer for the boiler feed pumps if they are required to draw treated water direct, in case the deaerator is out of service.

Heat Balance

A heat balance diagram for normal load on the plant is shown in Fig. 6. Steam for heating the feedwater in the deaerator is obtained from the exhaust of turbine-driven high and low-pressure boiler feed pumps, turbine-driven treated water pump, turbine-driven blowers, flash from continuous blow-down tank and a reducing valve between the 200 psi steam main and the 5 psi exhaust line.

Deaerating Heater

The Permutit deaerating heater is divided into two compartments, one for condensate, the other for treated water.

Condensate return of 50,000 to 100,000 lb per hr is pumped from process through a detention tank and discharged uncontrolled to the condensate section of the heater where it is heated and deaerated. Depending on the number of high-pressure boilers on the line, from 25,000 to 50,000 lb per hr of condensate flows to the suction of the high-pressure feed pumps and the balance spills into the treated water section of the heater. The purpose of this preferential arrangement is to insure feeding of condensate to the high-pressure boilers instead of a mixture of condensate and treated water.

Treated water make-up is fed through a float-controlled valve into the treated water section, where it is heated and deaerated. Thence it flows to the suction of the low-pressure boiler feed pumps.

If the condensate becomes contaminated and must be dumped, a low-water-level controller on the condensate section of the heater admits water from the treated water section to the high-pressure pumps. Contamination from hydrocarbons is checked by means of an odor detector located in the pump room.

The deaerating heater is located out-of-doors and supported on the roof of the pump room.

Draft System

Four reinforced-concrete chimneys, each 8 ft-6 in. diam by 175 ft high and connected as shown in Figs. 2 and 3, provide natural draft for the twelve boilers. Since no heat recovery apparatus was installed with the boilers, induced-draft fans would have been objectionable with the high exit flue temperature and were not needed to give draft required with a reasonably high chimney. Furthermore, induced draft for twelve boilers would have utilized a considerable amount of critical material in fans, drives, ducts and controls.

Fuel Oil Tanks and Storage

Two 131,500-gal prestressed, reinforced-concrete, underground, service fuel oil tanks are installed in the south section of the boiler plant area. The tanks receive fuel oil by a pipe line from a nearby refinery. To the west of the concrete tanks, a used steel tank of 735,000-gal capacity is installed for reserve storage.

Between the concrete service tanks and the boiler plant are placed two steam-driven reciprocating and one motor-driven, reciprocating, high-pressure fuel oil pumps. These pumps draw oil from suction type oil heaters located in the concrete service tanks and discharge the fuel through high-pressure heaters to the oil burners.

Water Supply

Investigation disclosed that water supplied by Metropolitan Water District of Southern California from the Colorado Aqueduct was satisfactory for process, but not for boiler make-up, but that water either from the Queen's River Aqueduct of the City of Los Angeles or from the local wells of the Dominguez Water Co., with proper treatment, could be made satisfactory for boiler make-up.

The final arrangements for boiler feed make-up were for a normal supply from the Dominguez Water Co. and a secondary or emergency supply from the City of Los Angeles.

Water Treatment

Consideration was given to the use of a hot-process system of water treatment for the boiler makeup but, due to the large amount of steel plate required in the manufacture of this equipment, it was decided to use a combination hydrogen and sodium zeolite primary treating system, using wood for softeners, detention, degassifier and storage tanks, platforms and stairways, with concrete mixing and clear wells. Steel pressure filters installed in the space between the softeners and concentrated acid and brine storage tanks are necessary to take care of algae in the Dominguez water to prevent plugging of softener beds. Secondary feedwater treatment with phosphate and sulphite is provided in the operating pump room.

Complete details of this water treatment system, with flow diagrams of primary and secondary treatments, will be presented in a future issue.

Three 12-ft-diam sodium softeners, three 12-ft-diam hydrogen softeners, one detention tank, one degassifier, one 50,000-gal backwash supply tank, one 50,000-gal treated storage water tank and two 50,000-gal condensate storage tanks are of wood construction. Brine storage tanks, mixing well, and treated water well are of concrete construction. Concentrated acid, dilute acid, brine measuring and coagulant tanks are of steel construction. Backwash, raw water, strong acid and chemical ejector pumps are located out-of-doors, but degassifier, coagulant feed and brine pump are located indoors.

Electric Service for Auxiliaries

Electric power for motor-driven auxiliaries of boilers and water-treating system is fed from the transformer station located south of and adjacent to the station switch room. In this room switches and contactors for the various electric circuits are located. An auxiliary switch room for the water-treating equipment is located south of the concrete, treated-water tank. An engine-driven generator for emergency lighting is installed in the fuel-oil pump house. Annunciators in the centralized boiler control room and in the coagulant pump room give alarms and indicate by signals to the operators that equipment is out of function and requires attention. A diagram of electrical circuits is shown in Fig. 5.

Acknowledgments

As stated above, this plant was designed and constructed by Stone & Webster Engineering Corp. for The Dow Chemical Co. and Defense Plant Corp. We are particularly indebted to W. F. Ryan, Assistant Chief Mechanical Engineer of Stone & Webster, for the technical details given above. We wish also to acknowledge the cooperation of G. M. Hebbard, Plant Superintendent, Styrene Division, Dow Chemical Co., Los Angeles, Calif., in making the information available.

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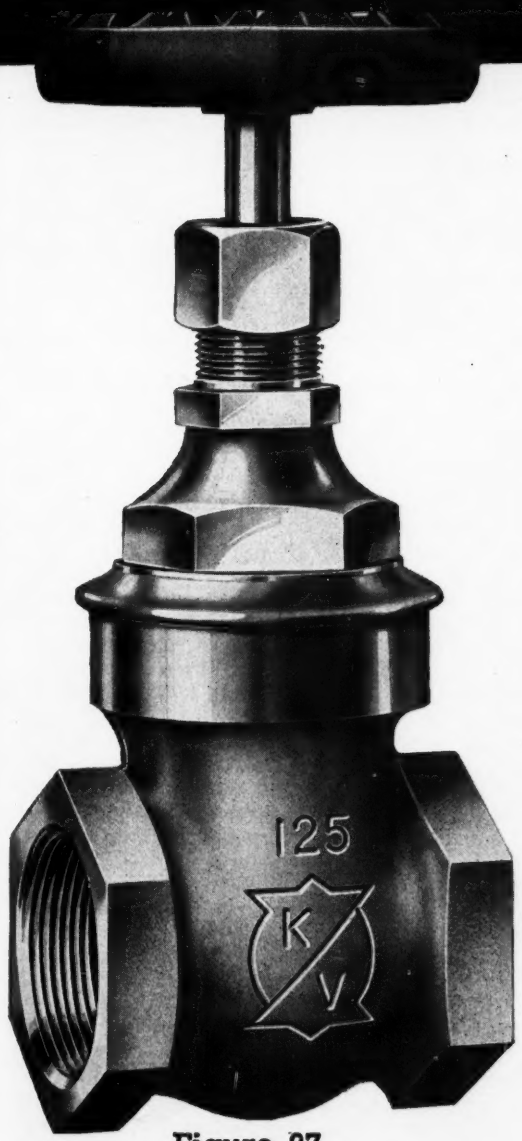

Figure 27
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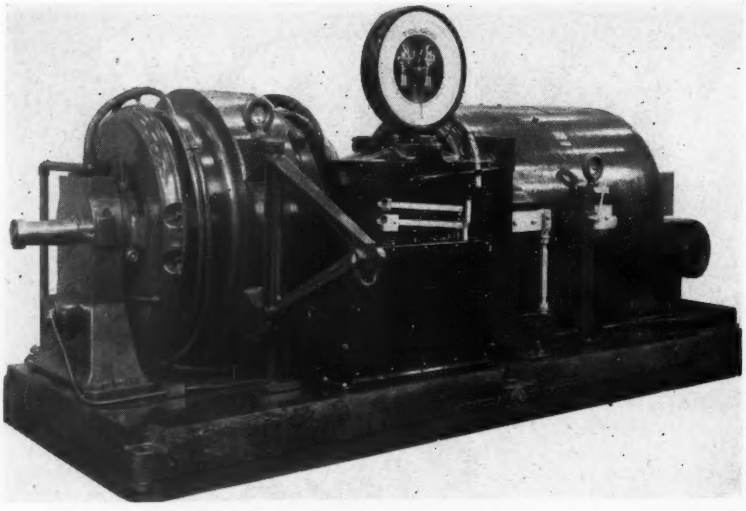

Fig. 2 G.E. combination electric dynamometer. This unit is similar to the solid-shaft combination part of the 3-unit dynamometers

(*Continued from Page* 89)

3. CURRENT LIMITS ON D-C UNITS (C) AND (G)—

When pumping back, the direct current is held at a preset value by amplidyne (3) acting on the field of unit (C).

4. LOAD DIVISION—

Torque arms of scale A and B-C are connected to selsyns whose angular displacements measure the torques of A and group B-C. Amplidyne control ensures that A and B-C evenly divide the total load. By further comparison of the load on B-C with that on C the loads of B and C are divided proportionately to their ratings or in any other desired proportions.

5. SPEED CONTROL—

The speed of the set is indicated by voltages from the tachometer generator (TG) which is matched with an adjustable reference voltage. The difference between these two voltages is applied as excitation for amplidynes (1) and (2) which in turn control the excitation of inductors (A) and (B). By adjusting the reference voltage the speed of the set is adjusted and is then held constant.

6. QUICK LOADING TO PREVENT ENGINE RACING—

Fast excitation or field forcing of inductors (A) and (B) as provided by amplidynes (1) and (2), is very important when the engine throttle is opened quickly, otherwise the engine would race before the inductors could provide a restraining load.

Detecting Oxygen and Water Vapor in Furnace Gases

OXYGEN, if present in heat treating atmospheres for steels, will rob the surface (sometimes even the interior) of carbon. This ruins the surface finish and softens the steel according to Westinghouse engineers. Water vapor at these temperatures also has a bad effect since it decomposes into hydrogen and oxygen. Water vapor, under such conditions, also appears to act as a catalyst in aiding decarbonization.

Presence of unwanted oxygen and water vapor in heat treating atmospheres is detected by passing the gas over a cool surface and by noting the temperature at which condensation occurs. This temperature of condensation (dew point of the gas) varies between —40 and —70 C, depending upon the requirements of the process. Even skilled operators differ in their estimates of dew-point temperature, especially when it is of the order of —40 C or lower. Furthermore, the process is not continuous and requires the operator to take periodic samples of gas to make the test.

An experimental device developed by Westinghouse utilizes electrons to do the detecting. The electrons furnish a continuous report of their findings to the operator. Oxygen and water vapor is ionized by electron bombardment, whereas constituents of furnace gases are not. The arrangement draws a sample of the gas mixture past an electron gun. As long as the gas is free of impurities, the electron current is constant. However, when oxygen or water vapor are mixed with the gas, some of the electrons are utilized in forming negative ions. This causes a measureable decrease in electron current. Most electron tubes are vacuum devices and the tube employed here is essentially a diode tube which operates with both ends open. The electron emitter and the plate continually operate in a stream of hot furnace gases.

This electronic dew-point indicator removes the difficulty of judging visually determined dew points, a method subject to considerable variation. Furthermore, it provides a continuous indication of gas quality. At present the new development is strictly a laboratory instrument and is not commercially available. Applications of the dew-point indicator will probably be restricted to certain types of furnace gases.

Copper Oxide Rectifier to Replace M-G Sets for Navy

POWER SUPPLIES for ship-to-shore radio sets are an example of things accomplished under pressure of the war emergency. Motor-generator sets have customarily been used to supply the three or four d-c voltages, according to Westinghouse engineers. Early in the conflict rotating machinery became a serious production bottleneck with long delivery dates. As a result, the Navy turned to Rectox-type copper-oxide rectifiers as an alternate because they were more quickly obtainable.

Several sizes up to 5½ kw were developed, using high-voltage, low-current type discs. They are forced ventilated by a small fan and are protected with Thermoguard-type thermostats. A low current continually passes through the thermostat but as long as cooling air flows over it, the contacts do not open. When the ventilation is stopped the Thermoguard acts quickly.

One version of the rectifier is unusual in that it is horizontal. Shape and dimensions are such that it can be substituted quickly for a damaged m-g set. It has the same output as the rotating power supply and meets the Navy's requirements for vibration, shock, and tilt. Its electrical characteristics are entirely satisfactory and it requires somewhat less maintenance than rotating machinery.

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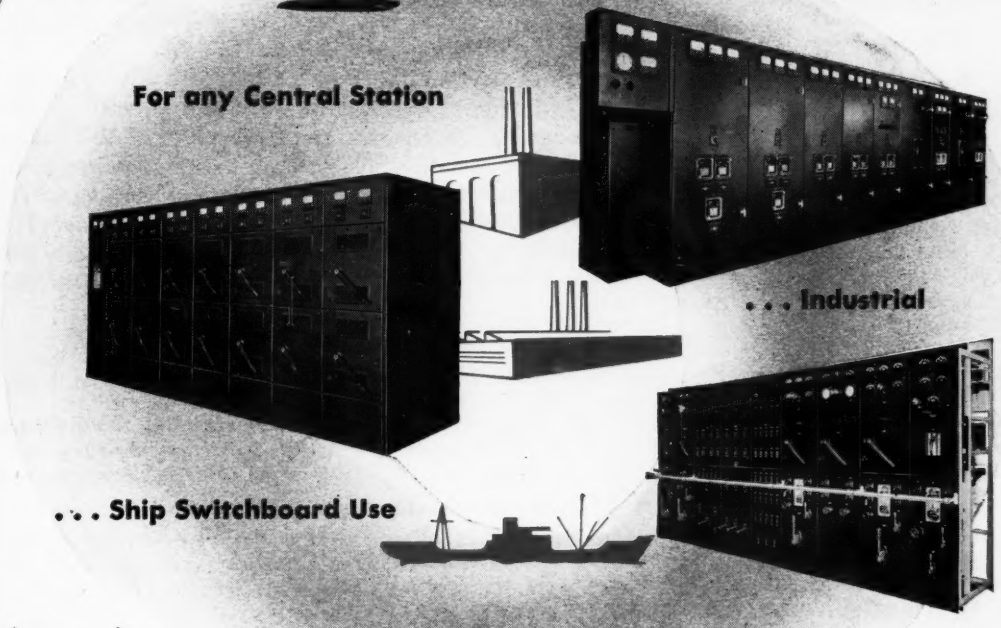

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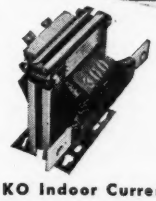

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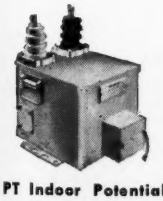

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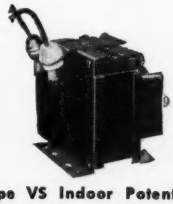
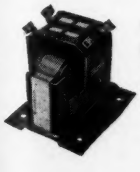


Type VS Indoor Potential Transformer. Primary rating 230 to 2,300 volts. Metering accuracy . . . heavy burdens . . . small size and weight.



Type CV Indoor Potential Transformer. Primary rating 115 to 600 volts. New lightweight design . . . small size . . . high accuracy . . . heavy burdens.

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Natural Circulation in 2500-psi Twin Branch Boiler[1]

By
W. H. ROWAND, *Mechanical Engineer, The Babcock & Wilcox Co.*
and
T. B. ALLARDICE, *Mechanical Engineer, American Gas & Electric Service Corp.*

Necessity for positive circulation in 2500-psi boiler . . . natural circulation selected . . . simple design with large downcomers . . . flow tested in various sections of unit . . . water level variations . . . orifices in downcomers improve stability . . . natural circulation problems, properly handled, have ceased to exist in units at pressures up to 2500 psi

AT THE TIME the decision was reached to build a 2500-psi natural-circulation boiler for a capacity of 550,000 lb of steam per hr at Twin Branch, the question of natural circulation for such a high pressure was thoroughly considered. After full study, the conclusion was reached that it was a sound and practical application, provided all the factors inherent in determining successful circulation were properly developed and taken advantage of. Reasons for speculation on this factor are understandable since the density differential between water and steam is only 28.4 at 2400 psi, whereas at 300 psi, this differential is 52, and at 1400 psi, it is 39.8.

The ability to circulate is a complex function of this density differential, so in order to utilize the differential that is available, it is of the utmost importance to prevent any steam being entrapped in the circulating water in the downcomers. At 2400 psi, the separating force of gravity is only 10 per cent of that at 300 psi, and only 29 per cent of that at 1400 psi; therefore, it is apparent that the difficulty in obtaining circulating water free of steam for the downcomers increases manyfold at the 2400 psi pressure level.

Simple Circulation Scheme

A simplified circulation diagram of the unit is shown in Fig. 1. The fundamental circulation scheme consists of a 28-in. diam downcomer pipe from either of the 54-in. diam drum. These pipes are carried down outside the boiler setting in order to keep the resistance losses at a minimum and to prevent the generation of any steam in the downcomers. Recognizing the effect of endwise flow of the circulating water along the drum on producing vortexes at the entrance of the downcomer pipe and on water-level stability due to the hydraulic-gradient phenomenon, a full-diameter half-length model of the drum and downcomer pipe was built and tested with water at Ohio State University in order to provide the best means for preventing vortexes entering the downcomers, and to determine the range of stable operating water levels with what was considered an ample excess of circulating-water flow above the design flow of 3,600,000 lb per hr.

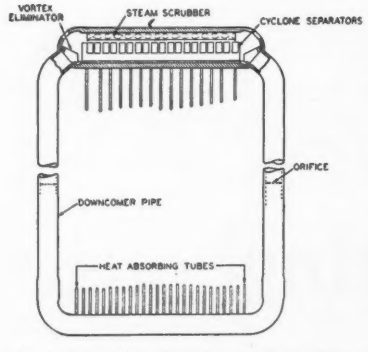

Fig. 1. Diagram of fundamental circulation in 2500-psi Twin Branch boiler

During the constructiton of the boiler, pressure taps for measuring differential heads across the various circuits and the fluid density in the downcomers, and pitot tubes for measuring the flow in the various circuits and in the downcomers were installed as shown in Fig. 2.

In the circulation calculations during the design stages of the boiler, a factor of safety was used in evaluating the average density over the height of the heat-absorbing risers. As shown by the results, this factor of safety was too large, since the total circulating flow on the original arrange-

Table of circulation test data for boiler circuits of 2500-psi boiler

	ABSORPTION RATE BTU/SQ.FT./HR.			VELOCITY ENTERING TUBES FT./SEC.			CIRCULATING FLOW LB./HR.			MIXTURE STEAM RATIO LEAVING			PERCENT STEAM BY VOLUME LEAVING		
TEST	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
FURNACE FRONT WALL	29,000	29,000	31,000	4.56	4.10	4.21	948,000	857,900	877,500	13.6	11.7	11.4	30.0	34.2	34.4
FURNACE SIDEWALLS	36,000	30,000	35,000	2.40	1.98	1.94	660,000	550,000	536,000	12.8	12.2	10.0	31.4	33.2	37.7
1ST DIVISION WALL															
CENTER SCREEN	24,000	26,000	31,000	3.18	2.91	3.11	502,000	462,300	491,700	8.4	7.4	6.1	42.2	46.5	51.6
END SECTIONS FROM SIDEWALLS	30,000	29,000	36,000	3.60	3.15	3.39	347,000	305,000	326,900	7.5	7.1	5.7	45.4	47.7	53.6
END SECTIONS FROM 2ND D.W.	24,000	28,000	34,000	4.51	4.33	4.62	434,000	419,400	445,400	9.2	7.5	6.4	39.7	46.1	50.2
SERPENTINE TUBES	16,000	22,000	24,000	3.05	3.08	3.37	168,500	171,600	187,000	8.2	6.5	5.7	42.9	50.3	53.6
2ND DIVISION WALL															
CENTER SECTION	22,000	24,000	28,000	4.15	3.84	4.20	599,000	557,800	608,000	12.0	9.5	8.6	32.9	39.5	41.8
"Y" TUBES	26,000	27,000	34,000	3.62	3.34	3.70	636,500	591,000	651,500	8.8	7.4	6.4	40.9	46.5	50.2
3RD DIVISION WALL	28,000	25,000	28,000	5.08	4.43	4.53	1020,000	895,000	911,000	6.7	6.6	5.8	48.6	49.8	53.1
TOTAL CIRCULATING FLOW							5,315,000	4810,000	5035,000						

TESTS	1	2	3
DATE	OCT. 10 1942	DEC. 4 1942	MAR. 27 1943
LB.STEAM/HR.	500,000	495,000	562,000
DRUM PRESS.-PSI	2310	2280	2300
ORIFICES	NONE	16¼" IN EACH DOWNCOMER	

[1]Abstract of paper Natural-Circulation Test Results on the 2500-psi Twin Branch Boiler presented before Annual Meeting, ASME, Nov. 29-Dec. 3, 1943, New York City.

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COMPARE	TENSILE STRENGTH	SHOCK RESISTANCE		TEMP-ERATURE LIMIT	CORROSION RESISTANCE (Relative)	VALVE COST (Relative)
		YIELD POINT	ELONGATION IN 2 INCHES			
ASTM 126-30 CAST IRON	34,000 LBS. PER SQ. IN.	0	0	TO 450°F		
ASTM 47-33 AIR FURN. MALL. GRADE 35018	53,000 LBS. PER SQ. IN.	35,000 LBS. PER SQ. IN.	18%	TO 450°F		
ASTM 95-36 CARBON STEEL	70,000 LBS. PER SQ. IN.	36,000 LBS. PER SQ. IN.	22%	TO 750°F		

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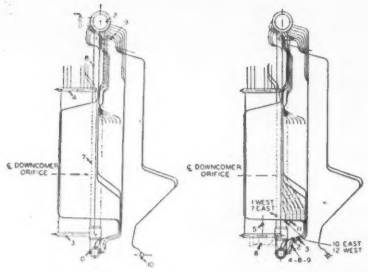

Fig. 2. Left—Static pressure connections for circulation test. Right—Pitot-tube locations for circulation tests

ment was 5,100,000 lb per hr rather than the design value of 3,600,000 lb per hr. Due to this additional circulation, some water-level instability, as evidenced by a slow surging in the gage glass, was encountered when the gage-glass water level was lowered to a point approaching the bottom of the glass, which was 9 in. below the drum center line. When the alterations to the heating surfaces were made,[2] the cyclone separators and the gage glasses were raised 2 in. which placed normal water level 1 in. below the center line of the drum rather than 3 in. below in order to provide additional flow area for the water along the drum.

Correction of Level Instability

Because of the larger diameter tubes and the additional circulation circuits which were added during the alterations, the total circulating flow was increased to 5,500,000 lb per hr after the alterations were made. This caused some water-level instability with the gage-glass level about 4 in. below the drum center line, and the flow resistance in the downcomers was so small that unbalancing the rate of firing across the width of the boiler by cutting out burners would cause a difference of water levels between the two ends of the drum of as much as 3 to 4 in. These two factors made the permissible water-level range between water-level instability and carryover too small for trouble-free operation above a load of 500,000 lb per hr.

To correct this condition, an orifice with a 16¼-in.-diam opening was placed in each downcomer during November, 1942. The circulating flow was reduced to 5,000,000 lb per hr at 560,000 lb steam flow, and the downcomer resistance was increased to 2.5 ft of standard water. This change has resulted in completely satisfactory operating conditions with no water-level instability or carryover occurring within the 12-in. visible range of the gage glass, and neither condition has occurred since this change, even with load changes from 500,000 down to 350,000 lb and back again in 3 or 4 min. Water levels at the two ends of drum are always within ½ in. of each other regardless of firing conditions.

Circulation Test Data

The table gives the pertinent circulation test data for the individual circuits of the boiler, as well as a comparison of the results at 500,000 lb per hr steam flow before and after installing the orifices in the downcomers. It also tabulates these data at a load of 562,000 lb of steam per hr after the installation of the orifices. The orifices reduced the total circulating flow and the average velocity entering the tubes approximately 10 per cent at 500,000 lb steam flow and decreased the mixture steam ratio (which is a reciprocal of per cent steam by weight) leaving the tubes from 9.4 to 8.3 on the average, which means an increase in the percentage of steam by weight from 10.6 per cent to 12.1 per cent. The average percentage of steam by volume leaving the tubes increased from 39.8 per cent to 43 per cent. At the overload of 562,000 lb per hr, the average mixture steam ratio is 7.2, and on the highest duty tubes is 5.7, corresponding to percentage of steam by weight of 13.9 per cent, and 17.5 per cent, respectively. The percentage of steam by volume on the average is 47.1 per cent and leaving the highest duty tubes is 53.6 per cent. These values indicate a large excess of circulation and a large margin of safety, in so far as any possible tube distress is concerned.

Conclusions

Since the tubes were changed to full-stud construction, the thermocouples at full load consistently show a range in temperature of the outside face of the tubes of 725 F to 785 F, which, with a saturation temperature of 655 F, indicates local absorption rates from 30,000 to 55,000 Btu per hr per sq ft.

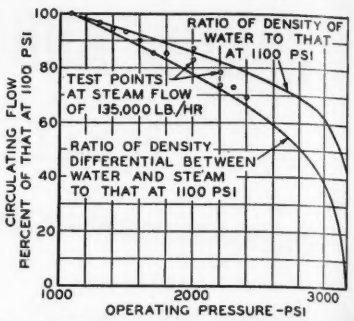

Fig. 3. Effect of pressure on circulating flow

Before the unit was placed in service, considerable public discussion had taken place in respect to excessive carryover of boiler-water salts in the steam at this high-pressure level, based upon theories advanced about steam solubility and the partial-pressure phenomenon. Actual operating experiences on this boiler, however, has proved that the purity of the steam is as good as, or better than, the majority of the units operating at pressures of 1400 psi and below. The conductivity of the steam is consistently about 0.8 micromhos, indicating solids carryover of about 0.5 ppm and an evaporated-steam sample showed 0.57 ppm. In the matter of turbine-blade deposits, the operating history is also as good as, or better than, the majority of the units operating at pressures of 1250 psi and below. A slow building up of stage pressure is experienced on the high-pressure machine, and this is corrected every few months by dropping the primary-steam temperature to about 750 F for 2 or 3 hr. There has been no indication of building-up in the low-pressure turbine.

The authors believe that the successful operation of this unit at the intended operating pressure since May, 1941, and the results of the extensive testing of the boiler, gives clear evidence for the conclusion that natural circulation is entirely practical and provides the necessary margin of safety for boiler-design pressures up to 2500 psi, provided that all factors inherent in the determination of successful circulation with steam generation at this pressure are considered and properly developed in the design of the unit. It may be stated that, properly handled, the problem of providing adequate natural circulation in boilers operating at pressures up to 2500 psi has ceased to exist.

[2] See POWER PLANT ENGINEERING, January, 1944, pp. 78-81; Operating History of the 2500-psi Twin Branch Plant, by Sporn and Bailey.

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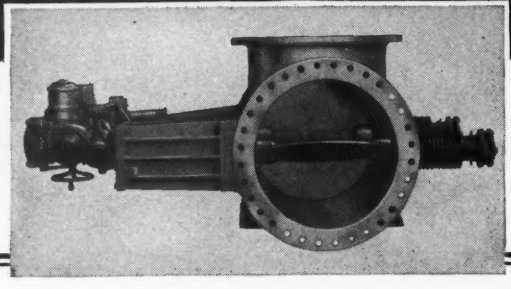

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Direct Contact Heaters On 5 Turbines at Buzzard Point Plant

(*Continued from Page* 76)

Corrosion detectors installed in the condensate system to show rates of corrosion give data as follows:

Unit No.	Location	Loss of Weight—Per Cent Per Year
1	Hotwell pump discharge	0.89
1	Boiler feed pump suction	0.389
1	Boiler feed pump discharge	0.30
1	Distilled water supply to cold surge tank (This is not deaerated)	2.16

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Performance of these heaters and accessory equipment, after making the improvements as stated, is very satisfactory.

Steam for the Dodge Chicago Plant

(*Continued from Page* 79)

2700-cfm, motor-driven machines. Motors for the above are Electric Machinery Mfg. Co. synchronous motors. Each compressor is equipped with its own air intake filter, aftercooler and air receiver. Cooling water is pumped through the compressors and aftercoolers to a cooling tower built by the Water Cooling Equipment Corp.

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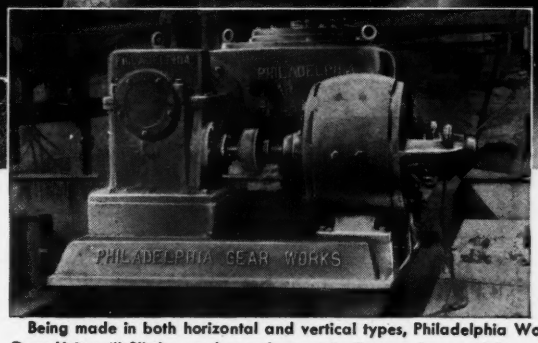

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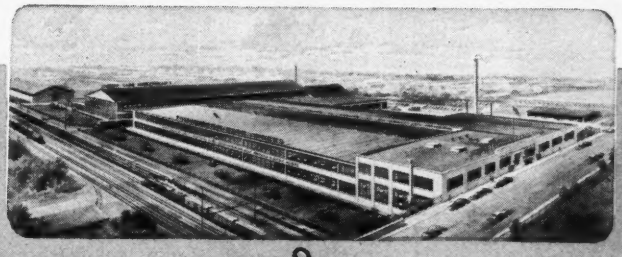

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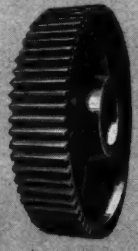

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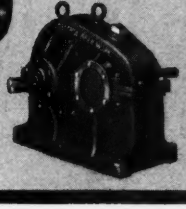

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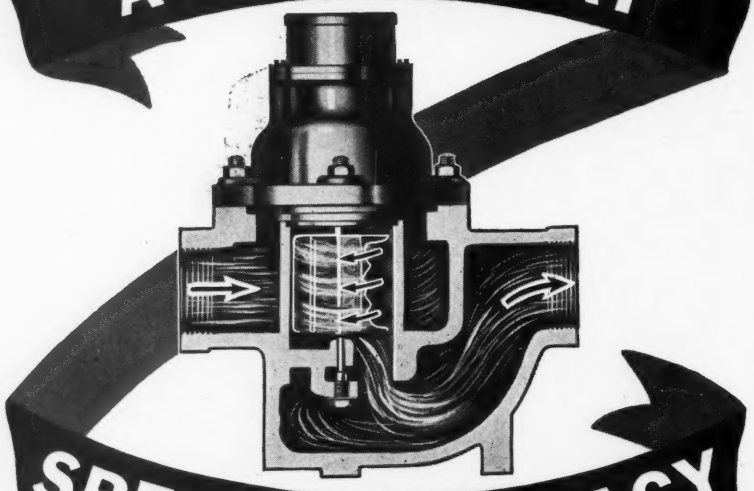

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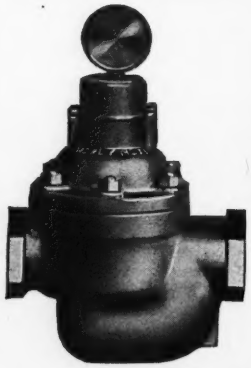

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arranged to feed coal from cars on a spur track to the boilers in a manner similar to that described for the smaller boiler house. The Main Boiler House requires two weigh larries, one specially designed to move in two directions for feeding the stoker hoppers of the W-type boilers, because the front boiler columns of these units are some distance in front of the stoker hoppers.

Ash, fly ash and stoker siftings are removed pneumatically by United Conveyor Company's "Nu-Veyor" system in a manner similar to that in the small boiler house.

Steam at 175 psi and 30 psi gage pressures, compressed air at 100 psi gage, condensate returns, and other services to the main assembly building are supplied through a tunnel 8 ft wide and 7 ft high. Steam and return lines to and from the foundry building run on an overhead wooden bridge about one-third of a mile long.

These two boiler plants together are capable of producing 1,000,000 lb of steam an hour and compressed air at the rate of 22,500 cfm of free air. The engineering problems presented and solved in a minimum of time were many and varied, and it has been stated that the results are satisfactory to all concerned.

Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich., were the architects and engineers for this project. The general contractor was Geo. A. Fuller Co.

Vertical 7000-kw Turbine-Generator Explodes

A VERTICAL 7000-kw steam turbine generator, Unit No. 8 at No. 3 Power House of South Works, Carnegie-Illinois Steel Corp., Chicago, Ill., exploded on the morning of January 25, wrecking itself and damaging other equipment in the plant. The unit was being operated under test and inspection conditions, preparatory to being placed in service but was not on the line. Normally a stand-by unit, it had been out of service for 8 weeks for general repairs, inspection and painting. The cause of the explosion has not yet been determined. Although steel production in the plant was not affected by the accident, four members of the plant engineering staff, who were supervising the testing of the unit, were killed by the explosion; another man, seriously injured, died later; and eleven other employees, including four women, received minor injuries.

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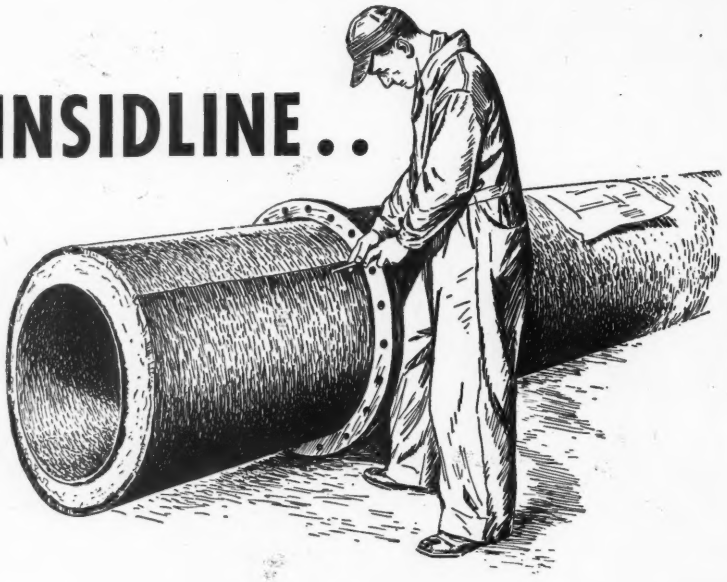

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Among the many problems confronting industry in the development of vital new war-materials was the problem of piping gases, superheated steam, and mixed vapors under pressure at temperatures ranging from 1000° F. to 1500° F. Ordinary carbon-steel pipe would not stand-up under these conditions and special alloy steel was not only expensive, but high on the critical list. .

Insidline, an internal insulation for pipe developed by Baldwin-Hill, supplied the answer. By holding the temperature of the outside piping to 650° F. or below, ordinary pipe can be operated indefinitely at the usual stress allowances. At the same time, heat-conservation can be carried to any degree desired.

In pipe over 36" in diameter and up to 100" or more, a panel-type insulation is built-up inside the pipe. For diameters under 36", a cartridge-type is assembled first and then drawn into the pipe. Send for booklet giving complete details.

Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, N. J. Plants in Trenton, New Jersey, Kalamazoo, Michigan, and Huntington, Indiana.

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

Fisk's New Unit in Operation

COMMONWEALTH EDISON Co. on January 20 placed in service a new 147,000-kw turbo-generator at its Fisk station, 1111 Cermak Road, Chicago, Ill. This machine, completed after more than two years of planning and construction, is the largest steam generating unit to be built in this country since the beginning of the war and is an assurance that the demands for power to run war production plants will be met by the utility company.

The new Fisk generator, which feeds energy into the power pool embracing the territories served by Commonwealth Edison Co., Public Service Co. of Northern Illinois, Western United Gas & Electric Co. and Illinois Northern Utilities Co., could supply the electrical requirements of a city of 300,000. At full capacity, it could have carried Commonwealth Edison Co.'s entire peak load of 35 years ago.

In an informal ceremony, Charles Y. Freeman, Chairman, turned the steam throttle valve which started the turbine's operation. Also participating were Edward J. Doyle, president of the utility; Harry B. Gear, vice-president in charge of operating and engineering, and A. G. deClereq, vice-president in charge of service and construction.

"We are pleased and proud to add this unit to our system because we know the kilowatthours it generates will help hasten victory," Mr. Freeman, said. "Forty per cent of our total electrical output is now going into the production of planes, ships, tanks and other materiel of war.

"The new machine represents an increase of 140,000 kw in the capacity of the Commonwealth Edison group of companies, 7000 kw being required for station auxiliary use. This brings our aggregate system net capacity to 2,254,000 kw, with a peak load to date of 1,928,000 kw registered on December 15."

Operating at a speed of 1800 rpm and at a steam pressure of 1300 psi, the Fisk unit embodies the most advanced design features contributing to high efficiency and economy. It is driven by two pulverized coal-fired boilers with a combined capacity of 100 tons of coal per hour. The boilers are capable of delivering 1,500,000 lb of steam per hour. The Allis-

Ask POWELL for the Answer to all your VALVE requirements

Pictured below is one of the latest and most modern power plants in the United States. Like other leaders in the industrial world, the experts who selected the machinery and equipment for this plant believed it wise to "ask POWELL for the answer to their valve requirements."

For every operation in the power field that requires flow control, POWELL has the correct valve. The valves shown here are especially suitable for *low-pressure steam* and *water* lines.

The Wm. Powell Co.
Dependable Valves Since 1846
Cincinnati 22, Ohio

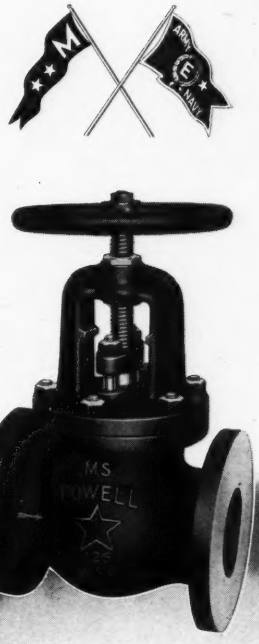


Fig. 241—Iron Body Bronze Mounted Globe Valve for 125 pounds W. S. P. at 450 F. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. This type of valve is also available for 250 pounds W. S. P. Sizes 2" to 12", inclusive.

Fig. 559—Iron Body Bronze Mounted Swing Check Valve for 125 pounds W. S. P. at 450 F. Has flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Sizes 2" to 12", inclusive. Also available for 250 pounds W. S. P. in sizes from 2" to 10", inclusive.

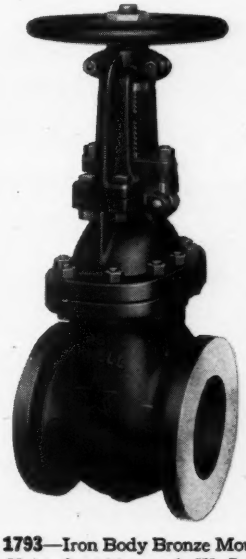
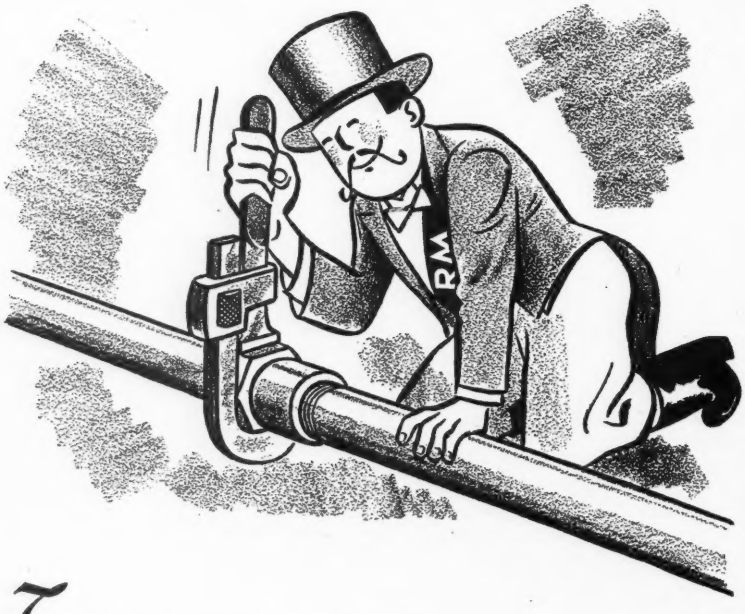


Fig. 1793—Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. at 450 F. (12" and smaller), 100 pounds W. S. P. (14" and larger). Has flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat and taper wedge solid disc. Sizes 2" to 30", inclusive. Also available for 250 pounds W. S. P. in sizes 2" to 24", inclusive.

POWELL VALVES

JOIN UP *with* R/M SHEET PACKINGS



The right connections are vital today —the kind that hold the line against the higher pressures of forced production. There are R/M packings for every type of piping problem, and their performance under all kinds of abnormal, war-time conditions is high tribute to the years of research and development. If you find it difficult to obtain R/M packings for the present, please remember high priorities must be served.

ARMY E NAVY

Awarded to R/M North Charleston Plant

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

Chalmers Manufacturing Co. constructed the turbo-generator and Babcock and Wilcox Co. the boilers.

Outlook as Viewed by Ferguson Co.

ACCORDING TO a consensus of opinions from leading members of The H. K. Ferguson Co., industrial engineers and builders of Cleveland and New York, emphasis during 1944 in the field of industrial engineering and building will be placed definitely on design work for post-war plant conversions, expansions and additions. Some of the points summarized from the survey of more than 20 of the top members of that organization are given in the following paragraphs.

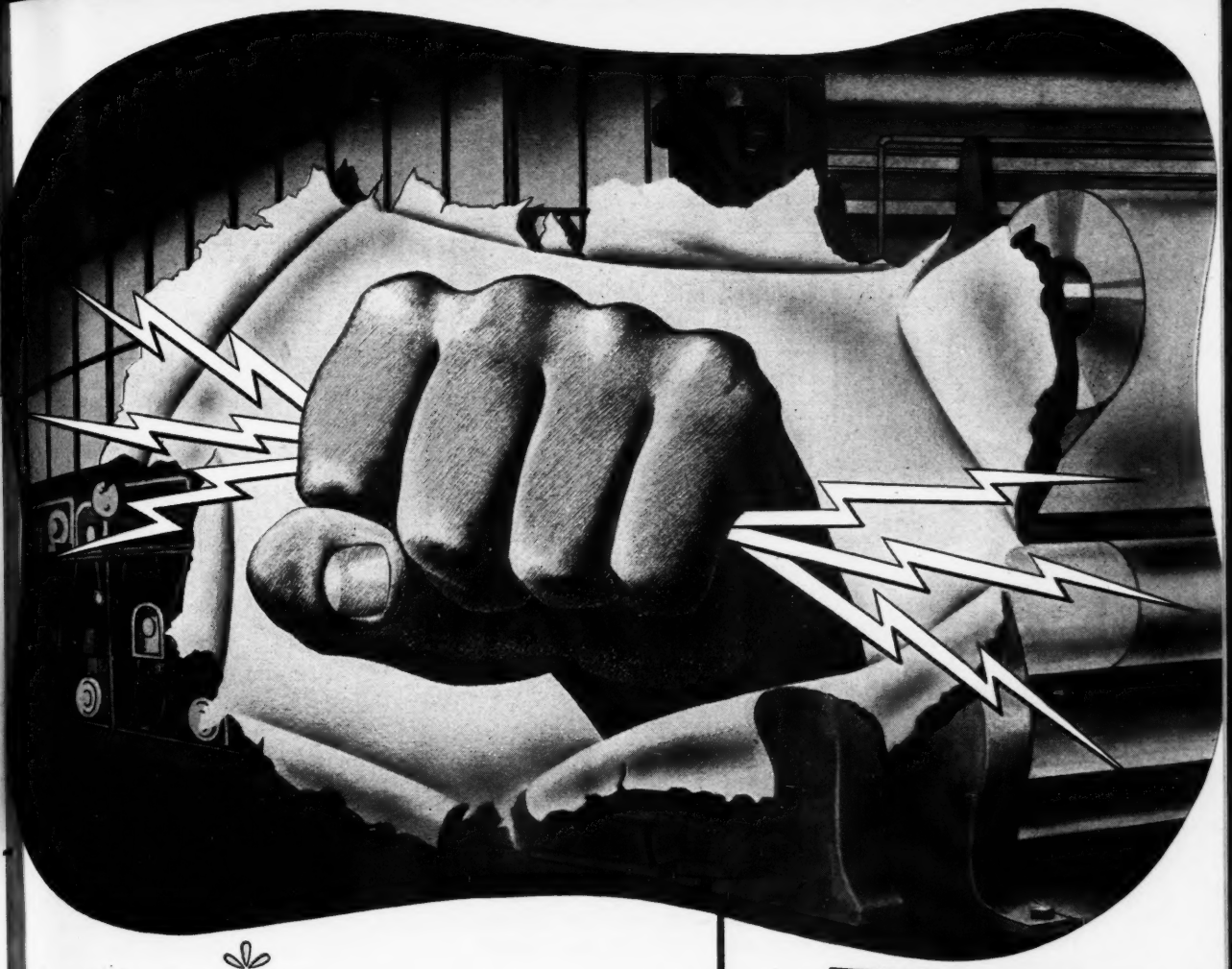
Reconversions of plant facilities already are under way in some instances. Many Government plants have shut down. Some are, and have been, actually converted to other purposes. Others are being wrecked, dismantled. The result is that we are entering industrial conversion much like we would be going into a real estate boom. Nobody knows the full picture.

Some construction materials are now available for use in sufficient quantities, among them steel and lumber, but controls are still being maintained by Government agencies. By late summer we can hope for War Production Board releases on certain items. Top military and production men will then know better our material requirements for the future because the European invasion pattern will be set.

A shortage of designing and construction engineers is likely to develop. It is therefore important for corporations to plan early, to make detailed drawings, specifications to write up and actually place purchase orders for future delivery. Men are now available; competent organizations are intact.

The peak in building costs has not yet been reached. Post-war costs will be higher per unit than war costs. A run-away market may be expected once the post-war building program starts. That's a factor to consider in drawing up plans now, having them ready just as soon as materials are available for "civilian" consumption. By having them finished early, top market prices can be avoided.

It is true that the country is



O.S.* HOLDS POWER AT ITS PEAK IN PAPER MILL TURBINE

There's no lag in power at the Monroe Paper Products Company. The superior oxidation stability of Shell Turbo Oil sees to that. In fact, a sample drawn from this hard working turbine after 25,920 hours of continuous operation showed the ability of Shell Turbo Oil to *resist oxidation* to an unusual degree. It was as clear as the day it was put into the system! Moreover, in addition to its exceptional *oxidation stability,* Shell Turbo Oil also provides *protection against rust!*

Draw a sample of oil from your turbines. Compare it with the analyses of Shell Turbo Oil at right. Can the oil you now use match this performance?

For details on this and other outstanding performances of Shell Turbo Oil see the Shell man. Or, write Shell Oil Company, Inc., Dept. "H", 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, California.

CERTIFIED PROOF OF THE SUPERIOR

*OXIDATION STABILITY

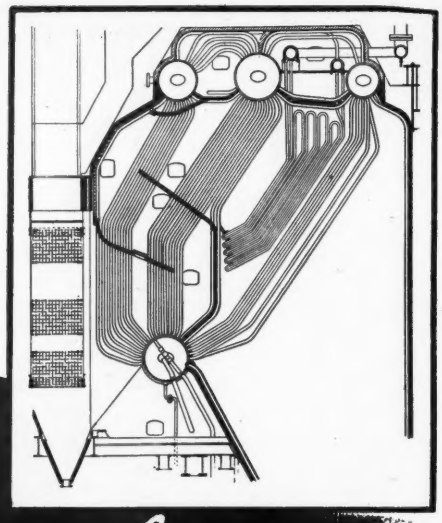
OF SHELL TURBO OIL

CHARACTERISTICS		
150-170	*Viscosity @ 100° F.*	168
Clear	*Appearance*	Clear
.05	*Neutralization No.*	.05
.1	*Saponification No.*	.2

Performance record of Shell Turbo Oil in a unit of the Monroe Paper Products Co., Monroe, Mich.

SHELL TURBO OIL

Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil



Streamlining SAVES FUEL

MODERN methods of baffling boilers have reduced flue gas temperatures and draft losses, with a resulting increase in efficiency, capacity, economy of operation and ultimate saving of fuel.

Enco Streamline Baffles are built gas tight and at any angle across the tubes, or interbank spaces, in all water tube boilers. The construction provides for easy removal of tubes and is a life time job.

The long sweeping curves promote the smooth rapid flow of gases over practically every square foot of the heating surface — gas passes are tapered in correct proportion to the contraction of the gas as it cools to maintain gas velocity. Bottle necks, dead gas spaces and soot pockets are eliminated with resulting better heat-transfer and minimum draft-loss.

Flexibility in design and construction permits baffles to be placed in the most effective position instead of a convenient, location for easy installation.

Since boilers differ as to size and location of superheaters, number of drums, location of damper, nature of fuel, use of arches, water walls, etc., the design of an Enco baffle for each boiler is an engineering study which requires, and gets, individual study.

FREE BOILER BAFFLES

● *A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 44 It's free.*

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

"over-built" in total volume of factory floor space. But the floor space is generally not located in the proper places for economical use. The reasons are legitimate, the principal one being that sites for wartime plants and sites for peacetime plants don't have the same requisites.

C. A. Harwick, Vice President, The H. K. Ferguson Co., stated specifically that the year 1944 will bring about a great deal of planning for post-war industrial building, some of which will be permitted for actual construction by the War Production Board before the war ends, in a tapering process as manufacturing cancellations increase.

Restrictions will be relaxed gradually to act as a cushion to absorb some of the pressure from cancelled war contracts. There will be an increasing volume of planning as part of research work which many companies hope to execute on the completion of the war.

The Government will look kindly to some construction as soon as hostilities cease in Europe. Because of manpower problems, the restrictions will be less rigid in some geographical areas than in others.

Dollar volume of building in '44 will be substantially less than in the past year. The industrial construction that is allowed will be designed only to break bottlenecks, and in this connection, there probably will be a few special types of plants to meet the changes of emphasis in war requirements.

On the other hand, there will be a definite increase in the volume of industrial engineering. Many corporations are making plans to have plant requirements ready to help absorb the men returning from the armed services, and the increased prominence of industrial engineering will start moving ahead immediately.

J. Stuart Sneddon, Vice President of the company is of the opinion that most business and industrial companies are thinking of, or are actually engaged in, post-war planning. In many instances, preliminary engineering studies are under way and some concerns are completing working drawings. The greater degree to which ideas are made specific and working drawings completed, the greater advantage will be obtained by those ready to act at

BELIEVE IT OR NOT . . . IT'S ONE PIECE!

This heavy, curved welding neck looks like several fittings welded together. That would be the easy way to make it, but the particular condition it serves requires a one-piece forging.

Turning out a hollow forging like this—involving a flanged, curved, and upset section—is a tough undertaking. And yet it is typical of the kind of jobs that many people feel we are better qualified to handle than any other forging plant.

Yes, doing things with hot metal that nobody else does—knowing how to control its flow under pressure and impact — has been our specialty here for a good many years.

It is the "know-how" acquired in these special undertakings that explains why we are able to make WeldELLS and other Taylor Forge welding fittings, the fittings that have "everything" . . . why you find in WeldELLS extra metal properly distributed where service stresses are greatest . . . why WeldELLS have tangents . . . why all dimensions are so extremely accurate.

Just check the list of features, opposite, and we believe you will agree that WeldELLS indeed have everything conducive to sound engineering and utmost economy in every pipe welding job.

No other fittings for pipe welding combine these features found in WeldELLS:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS *have everything*

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HOW YOUNG IS AN "OLD" DART UNION?

. . . YOUNG ENOUGH TO GO BACK TO WORK AND DO A GOOD JOB

Even though Dart Unions have been used time and time again, they *still* can work hand in glove with "young" Darts . . . and give dependable, economical performance.

The reasons *behind* a Dart's extra values are so important to you that we bring them to your attention often. Reason Number One is that Darts have matched bronze seats, ground to true-ball surfaces. Reason Number Two is that Dart bodies and nuts are made of high test malleable iron which resists rough handling and rust.

And may we suggest that you get *all* the service that "old" Darts have to offer by searching your plant for them and putting them back to work. It is a wise and patriotic thing to do . . . just as it is wise and *necessary* to see your supplier if you need *new* Darts.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

the psychological time when materials are made available and to take advantage of the best prices in consideration of an upward surge in the market at some future date.

In construction, almost every business and industrial plant must go through conversion stages to a more or less degree. The maximum amount in dollar volume will be rearrangement and replacement of equipment. The next volume will include the preceding, but will require additions to existing buildings and other space to be properly prepared for expanded business. Third, many companies will acquire strictly war plants for peacetime purposes and probably will require both equipment changes and building alterations. In some few cases, complete new plants on new sites will be required.

As in every war period, new ideas are born and put into practice at an accelerated rate which carries over through the following business cycle. This is illustrated by the number of concerns contemplating research and development laboratories.

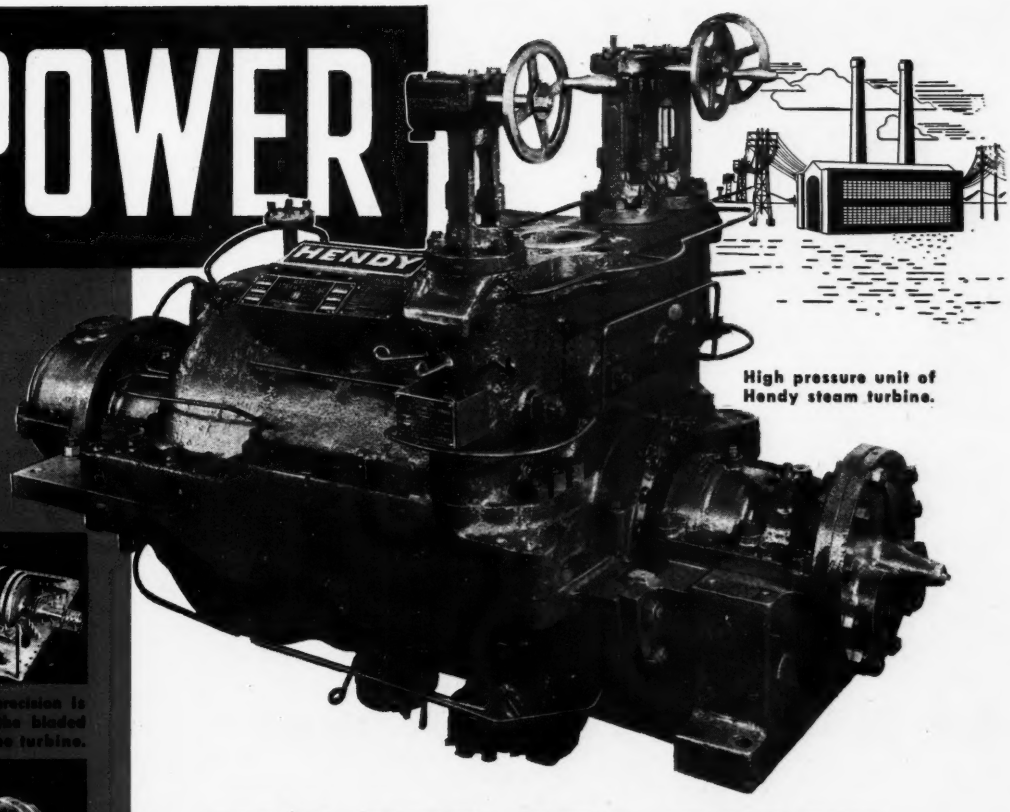
Construction-wise, thinks Mr. Sneddon, 1944 will be active to the degree that war curtailment and Government authority permits acquisition of materials and equipment. As the successful progress of the war continues, this degree of activity will increase. When the European war is concluded, the full surge of the categories of work outlined should take place in '44 or some subsequent date.

Capacity of Utilities Nears 50,000,000 Kw

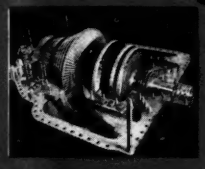
IN ITS year-end review for 1943, the Edison Electric Institute makes the statement that the installed capacity in the public utility power houses increased during the year by more than 3,000,000 kw bringing the total at the present time to about 49,500,000. During the past five years, generating capacity has grown by almost 11,000,000 kw, which increase alone is greater than the entire capacity of all the country's power houses at the beginning of the last war.

In 1943 the electric utility companies of the United States spent for new construction in round numbers, $265,000,000. This compares with a total of $456,000,000 in 1942 and a budget of $282,000,000 proposed for 1943 at this

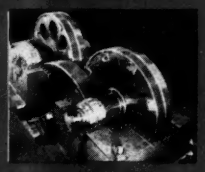
POWER



High pressure unit of Hendy steam turbine.



The utmost precision is essential in the bladed spindle of the turbine.



Hendy marine reduction gear unit for the 4,000 hp C-3 power plants.

THE BALANCE OF POWER

The assurance of long life and low maintenance for a turbine depends on how well such a power unit is balanced. One way is to build them—and then compensate for weight differences. But the correct way is to build each of the 4,000 parts so meticulously to precision dimensions in the first place that the unit doesn't have to be balanced by supplementary means. Then it will always remain in balance for there's nothing artificial about it!

For a smooth-running vibrationless unit—you can rely on the "balance of power" in a HENDY built turbine.

FOR THE SEA TODAY
...for INDUSTRY tomorrow

Challenged to put steam turbines on a mass production basis, Hendy telescoped into twenty months a decade of turbine manufacturing progress. In doing so a new chapter has been written in the history of turbine production, and as well new standards of quiet, smooth turbine performance have been created by the Hendy product.

Now entirely for marine service, the output from Hendy includes turbines for 300 kw generator sets, 4,000 hp, 6,000 hp and 8,500 hp turbines for propulsion of cargo ships—in addition to complete reduction gear units for them.

Post-war industry will find performance in Hendy turbines—will find them prime movers whose dependability has been thoroughly established in war service.

JOSHUA HENDY Division
JOSHUA HENDY IRON WORKS

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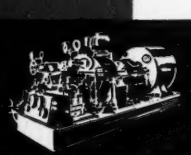
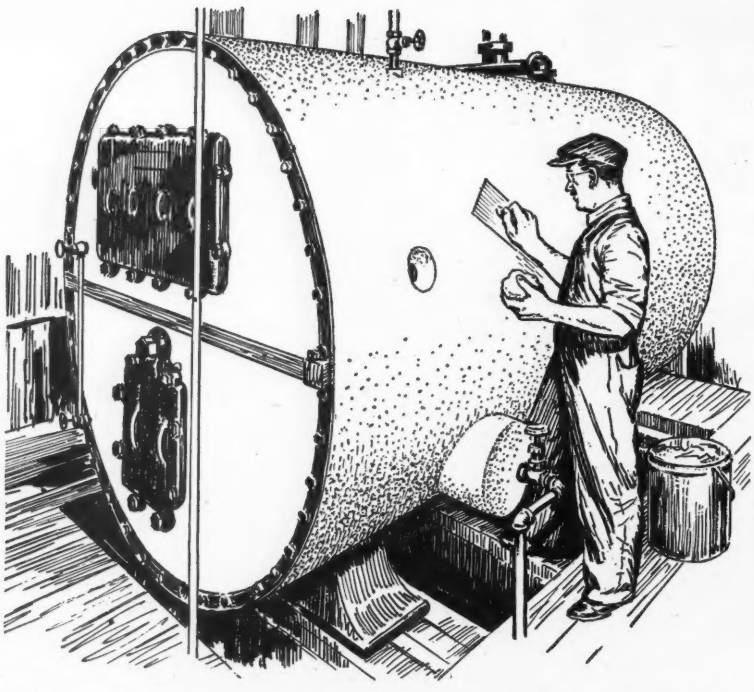


TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES



AN INSULATING CEMENT THAT

stays put

Once it's on, it's on to stay — and that means real savings in time, money, and materials.

Baldwin-Hill No. 1 Insulating Cement contains a special rust-inhibitor that prevents corrosion between metal surfaces and the cement. Whether the cement dries out immediately on a hot surface, or air-dries over a long period of time, it will not affect the bond. Ordinary expansion and contraction of the insulated surface are not problems, either. B-H No. 1 Cement is elastic enough so that it will not crack and peel.

Made of B-H *black* rockwool, it is effective up to 1800° F. It is the ideal maintenance insulation for valves, fittings, and large pieces of equipment where molded-type insulation is not practical. Makes an excellent finish, too, for covering blanket and block applications. Send for sample and information.

Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, N. J. Plants in Trenton, N. J., Kalamazoo, Mich., and Huntington, Ind.

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BH COMPANY

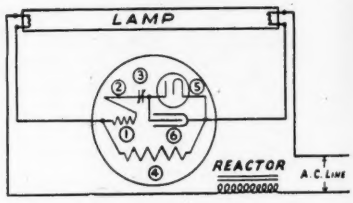
HEAT & COLD INSULATIONS

time last year. Construction expenditures for 1944, based upon budgets thus far announced, will approximate $225,000,000, or only slightly less than this year's actual construction. Much of this proposed expenditure is for distribution lines, a substantial part of which is destined to serve farms for increased food production.

Fluorescent Starter

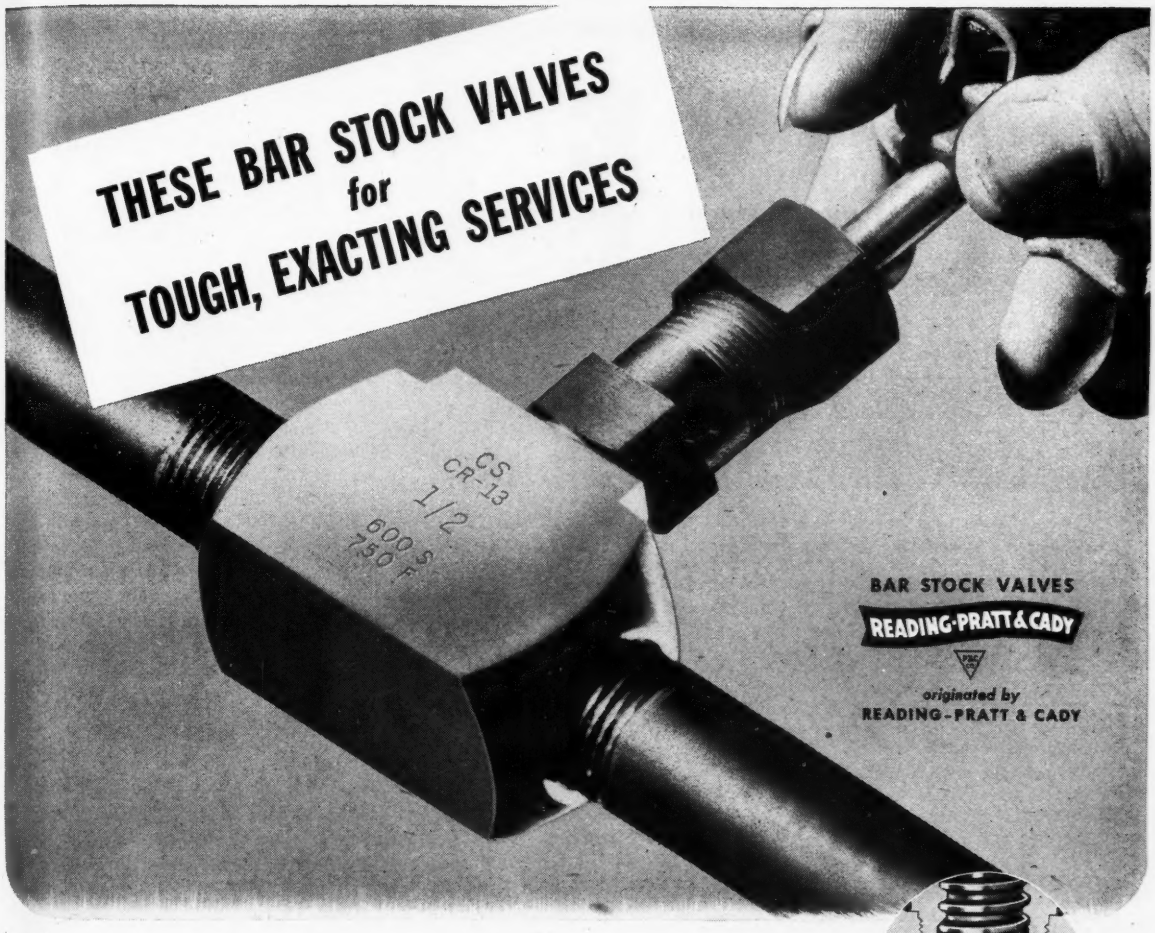
FLUORESCENT LAMPS do not burn out suddenly. Instead, they try to start but are unable to sustain the arc, according to Westinghouse engineers. The result is a periodic flashing of the lamp that continues until the lamp is removed or the circuit is interrupted. Meanwhile, the repeated attempts at starting are annoying—they also seriously shorten the life of the starter.

Westinghouse engineers have developed a starter that preheats the cathodes in the usual manner. It also interrupts the circuit when the lamp becomes deactivated or reaches the end of its life. This "no-blink" starter is available for 40- and 100-w lamps.

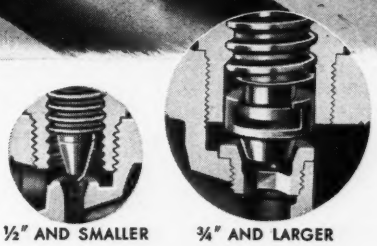


Circuit diagram for new "no-blink" fluorescent lamp starter designed by Westinghouse engineers. Low resistance heater (1) carries the starting current, and as the glow switch attempts to start a deactivated lamp, gradually heats the bi-metal (2) and opens lockout contacts (3) in the glow switch (5) circuit. Open circuit voltage then exists across resistor (4) which draws a negligible current (power less than 1 watt), but produces sufficient heat to hold lockout contacts (3) open. When the failed lamp is replaced the starter automatically resets to its normal position ready to function again. Condenser (6) eliminates radio interference

The new starter utilizes a simple form of thermal switch in series with the timing switch. When the lamp is in good operating condition the starter functions normally—it merely provides the time to start the lamp. When the lamp fails, the starter makes a few attempts to put it in operation. The resultant heat brings the thermal switch into play which then permanently opens the lamp circuit. The new device eliminates blinking and reduces current flow through lamp auxiliaries—this saves power. The starter is fully automatic.



● This READING-PRATT & CADY "original" gives you the full strength of bar stock metals, stems far heavier than might seem necessary and pipe threads longer than the effectives required by A.S.A. and A.P.I. standards. . . . It is a plug valve made in Globes, Angles and Thruport—Regular, Lock Bonnet and Indicator types, either threaded or with socket welding ends.



½" AND SMALLER ¾" AND LARGER

Some of the Uses of "Bar Stocks"

Made in these metals and combinations:

Bronze for air, water, gas, oil, etc., 500 lbs. at 150° F. . . .

Carbon Steel for non-corrosive gases, oil, other liquids, mercury, etc. to 4000 lbs. at 150° F. to 475 lbs. at 1000° F. . . .

12-14 Chrome Stainless for fluids such as cold nitric, crude oil, alcohol, ammonia liquor, soaps, boric acid, alkaline solutions, paint, Ethyl gasoline, mine water, to 4000 lbs. at 150° F. *Not* for higher temperatures. . . .

Combination 12-14 Chrome Stainless and Carbon Steel, principally a steam valve, but also for water, oils, gases at galling temperatures. 4000 lbs. at 150° F. to 475 lbs. at 1000° F. . . .

18-8 Chrome Nickel Stainless for 50% acetic, alum, 20% sodium hydroxide, saturated solution of calcium chloride, hydrogen sulphide, foodstuffs; carbonic acid, citric acid, sour crudes and gases and many other chemicals.

SEATING DETAIL

Especially long seating contact and fine spindle threads give close control and good durability. Port diameters—about the same as double extra strong pipe—give plenty of capacity.

Bodies are machined from Bar Stock on precision-set machines, assuring positive uniformity of body characteristics.

READING-PRATT & CADY

MANUFACTURERS OF

READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES

D'ESTE VALVE AND ENGINEERING SPECIALTIES

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A DIVISION OF **AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT**

SAVE COAL

—with FYR-FEEDER Multiple SPREADER Stokers

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of wet or dry bituminous coal you have available locally—screenings or sweepings, any melting point of ash, free-burning or coking coals.

Burns Coal like Oil: FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed—no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle increased loads.

FYR-FEEDER is **our own original** design. FYR-FEEDER is not a copy of any other stoker but our own invention developed by us, and our engineering experience with spreader stoker design, installation and operation began in the last century.

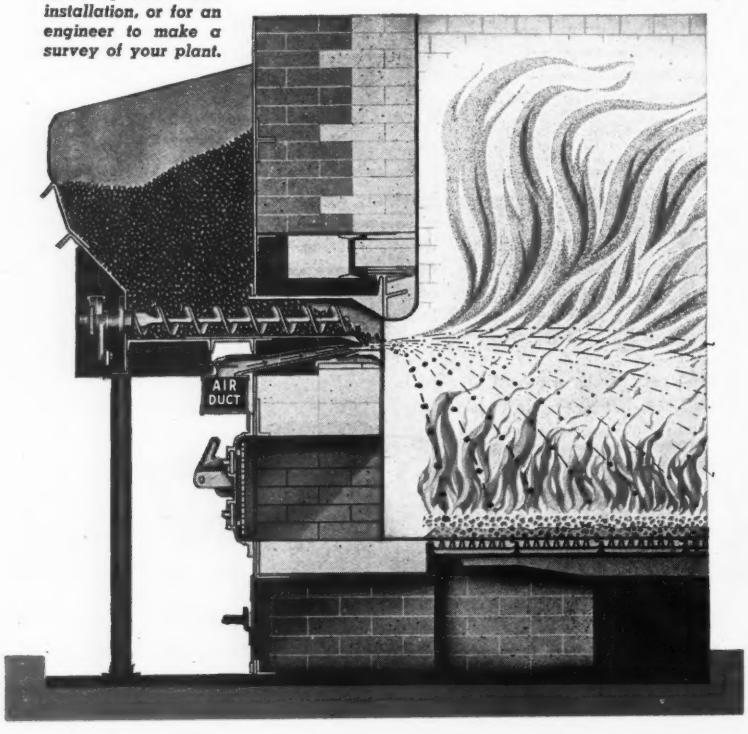
Coal men like the FYR-FEEDER because FYR-FEEDER users do not insist upon the delivery of "DRY" coal since FYR-FEEDER handles "WET" coal satisfactorily. Regardless of "rain and snow watered" coal, FYR-FEEDER stokers produce plenty of steam from "WET" coal. FYR-FEEDER was designed to use "WET" coal or dry coal.

AMERICAN COAL BURNER COMPANY

—*Engineers*—

***WRITE FOR CATALOG** describing features, operation and installation, or for an engineer to make a survey of your plant.*

22-18 E. Erie St. Chicago 11, Ill.



When the burned-out lamp is replaced, the starter automatically resumes its normal lamp-lighting function.

New Relay for Heavily-Loaded Long Lines

DISTANCE RELAYS that protect electrically-long transmission lines must be able to distinguish between load impedance and fault impedance. In other words, they must discriminate between a legitimate load and a fault, according to Westinghouse engineers.

Generally, the fault impedance is so small that the relay has no difficulty in discriminating between the two. But if the line is long and the load heavy the standard impedance relay would operate incorrectly during full-load conditions. It is becoming more common with wartime power loads, more interconnections and longer lines for impedance in a short circuit to be greater than that resulting from full-load current flow. A new relay was needed to meet these conditions. It must not operate on surges that do not upset system-synchronism. A relay must be provided with some different sense of perception. It must trip for faults but remain undisturbed for other load or surge conditions that do not pull the system out of step.

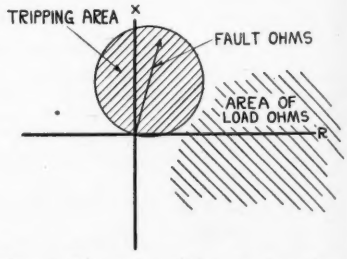


Diagram illustrating new long-line impedance relay characteristics. Device takes into account impedance angle and magnitude—especially necessary for heavily loaded long lines

A new long-line relay designed by Westinghouse engineers has this discriminating ability. The new design makes use of the wide difference in phase angle that usually exists between load and fault currents on electrically-long circuits. Load currents on long lines generally are near unity power factor—fault currents lag by 60 deg or more. The new high-speed impedance relay has characteristics which enable it to recognize not only the magnitude of an impedance but the impedance angle as well.

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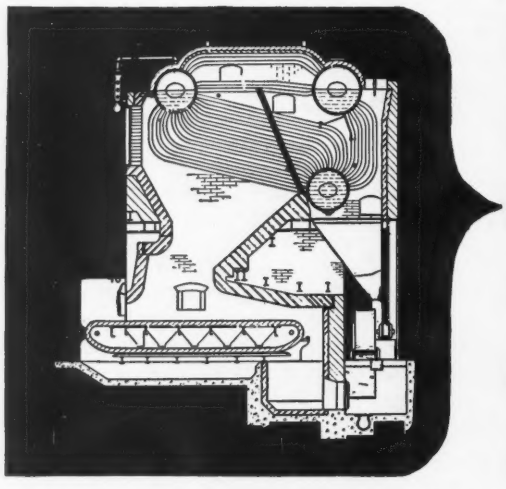

H-TYPE
A-TYPE
L-TYPE
RADIANT TYPE
4-DRUM
O-TYPE
LONG DRUM
CROSS-DRUM
UNIVERSAL STEEL-CASED
UNIVERSAL BRICK-SETTING
HORIZONTAL RETURN TUBE
LITTLE GIANT
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L-TYPE BOILERS

INVESTIGATE the complete line of Union Boilers. Type L, one of 13 Union basic Boiler designs, is a compact Low Headroom Boiler that will carry high ratings efficiently. Both Top Drums at the same level (neither submerged) provides the maximum steam disengaging area and a fast steaming rate through greater inclination of the tube bank. Steam crossover tubes exposed to the gases carry steam only and can be arranged to provide a moderate amount of initial superheat. Booklet L-3 tells the complete story. *Write for it today.*

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BOILERS

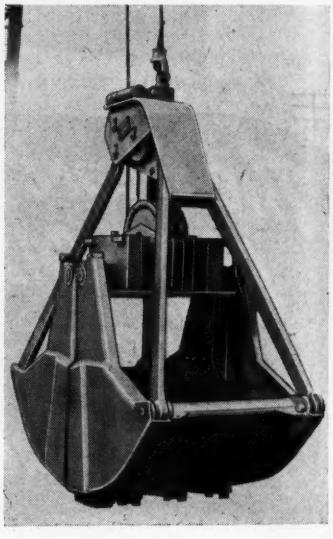
PRESSURE VESSELS • PLATE FABRICATION

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Welded Clamshell Bucket

THE C. S. JOHNSON CO., Champaign, Ill., has announced the development of a new all-welded clamshell bucket. One of the major operating advantages of this bucket is a removable manganese steel lip to provide many times the wear of ordinary mild steel construction. Closing sheaves are equipped with needle bearings which are protected against dirt and moisture by a special synthetic rubber seal. To prolong rope life, sheaves are of large diameter and guide sheaves have been substituted for guide rollers.



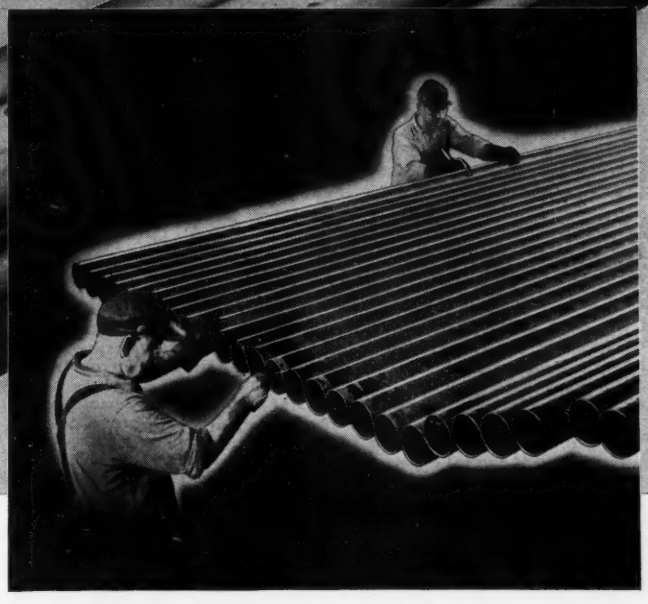
All-welded construction makes digging easier and faster, for there are no external bolt heads or rivets to slow up the operation. The welded design also permits greater stability since the weight can be exactly distributed. General purpose buckets are made in sizes from ½ yd to 2½ yd.

Blast Fan

THE AIR BLASTER is the name given to a new type of fan just placed on the market by Chelsea Fan & Blower Co., Inc., 1206 Grove Street, Irvington, N. J. The features of this unit are that it delivers a large volume of air in a straight line to the spot where it is needed, reaching more effectively into out of the way corners and dead air spaces. The discharge expands only slightly and continues as a high velocity air stream over larger distances than with conventional fan designs. It is especially designed for use in steel mills, foundries, shipholds and forge rooms, meat packing and cold storage plants, freezers and dairies, also for cooling condensers, ammonia compressors and transformers.

The unit consists of a heavy gage welded steel housing, mounted on an adjustable pedestal which may be tilted 60 deg up or down. It is driven by a direct connected, ball bearing motor. The

These Men



Are Hard to Please!

The men who inspect Globe pressure tubes have exacting ideas on how a steel tube should "measure up." They rigidly inspect all tubes, demanding that they be strictly within tolerance specifications. Wall thickness and outside diameter are carefully gauged. And, while in process and after completion, Globe tubes are subjected to all hydrostatic pressure, flanging, crushing and other tests that may have been specified. Globe pressure tubes are thoroughly annealed for uniform ductility and strength in the latest and most advanced type of continuous annealing furnace. Made from aluminum killed steel, fine in grain, and superior to silicon killed steel for pressure tube service, Globe tubes are right for rolling-in, beading, and flaring operations. They are unusually resistant to fire-cracking and splitting.

EXTRA CARE IN THE MAKING

is standard procedure with Globe Boiler and Pressure Tubes. Modern high-temperature, high-pressure service proves the value of such extra precautions to meet today's extra demands. Globe's insistence on the most severe standards

MEANS AN EXTRA MARGIN OF SAFETY IN SERVICE!

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★ CONDENSER AND HEAT EXCHANGER TUBES
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GLOBE STEEL Tubes

5006

GLOBE STEEL TUBES CO., *Milwaukee, Wisconsin, U.S.A.*

Just a drop of water-

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or is it?

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*

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TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

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fan blade is of heavy steel, die cut, die formed and carefully balanced.

Three sizes are available: 6000, 9000 and 11,000 cfm.

New Porcelain Clad Capacitors

FOR HIGH VOLTAGE D-C applications where space is limited, new solder-sealed porcelain-clad type FPC Interteen Capacitors are announced by Westinghouse Electric and Mfg. Co.

From 7500 v up to and including the 200,000 v class, the capacitor elements are hermetically-sealed in a tubular, wet-process porcelain body with solder sealed end closures. The end closures act as the capacitor terminal by connecting the element leads at opposite ends, utilizing the porcelain tube as insulation.

By eliminating the large metal case and bushings required by metal case capacitors, the new porcelain-clad capacitors help maintain minimum over-all dimensions. Larger types are furnished with or without cast mounting flanges. Where castings are used, the capacitors are solder-sealed, then castings are cemented on with mineral-lead compound.

Electric Level Control

UTILIZING ELECTRONIC principles, a new level control developed by Trimount Instrument Co., 37 W. Van Buren St., Chicago 5, Ill., maintains (or keeps within desired limits) the level of any liquid or electrically conducting solid

AIR VENTS on Dryer

Helpful Hints on Special Uses

FOR SARCO STEAM TRAPS

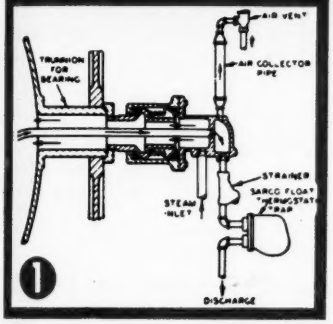
Sarco "steam" traps are also used to remove air from pipe lines, water from compressed air lines, as liquid level controls, steam injectors, condensate pumps, and as a simple, inexpensive form of temperature control.

Here are a few examples:

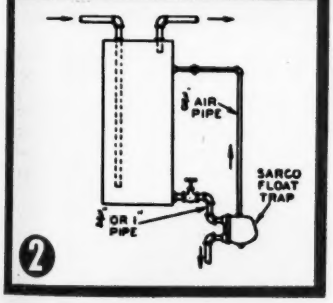
1. Sarco type H thermostatic trap as a simple air vent on rotating drums in a paper mill.
2. Sarco float trap draining water from compressed air receiver.
3. Sarco return trap pumping condensate from turbine to condenser.
4. Sarco liquid level controller maintaining water level in an open tank.
5. Sarco 87-C liquid expansion trap controlling outside storage tank.
6. Sarco 87-S heating water by direct steam injection and controlling temperature.

A hundred other suggestions are shown in the Sarco Hook-up Book — yours for the asking.

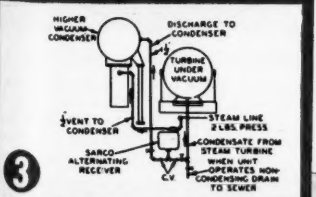
SIMPLE AIR VENT



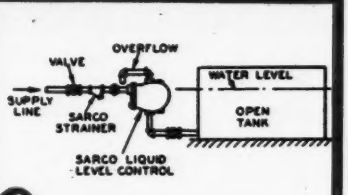
DRAINING AIR LINE



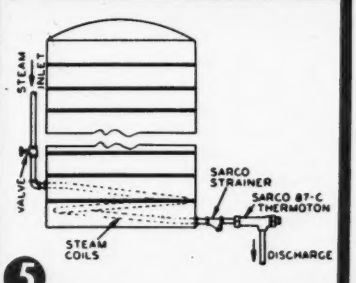
PUMPING CONDENSATE



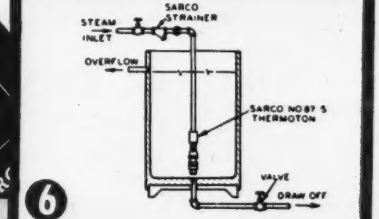
LIQUID LEVEL CONTROL

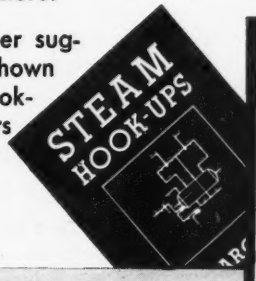


OUTSIDE TANK CONTROL



CONTROLLING OPEN TANK





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SARCO Saves Steam

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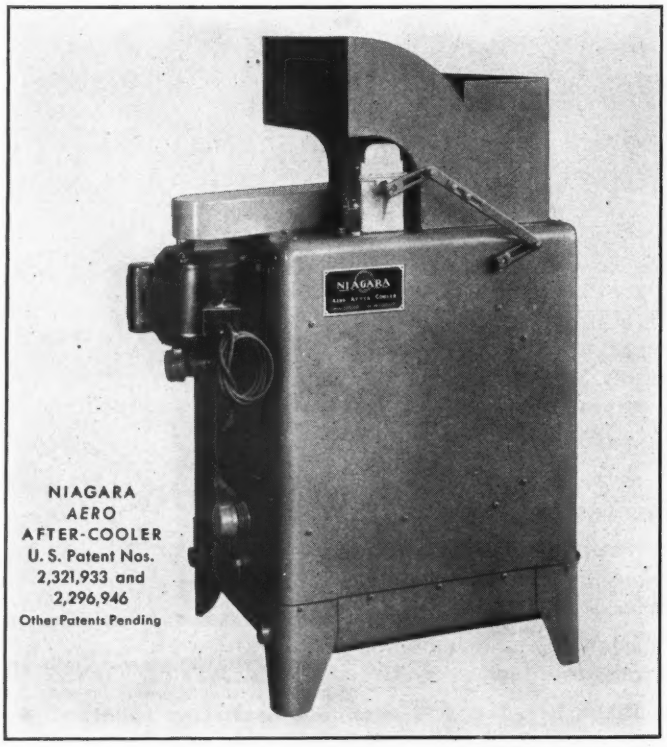
22

Keeping Water and Oil Out of COMPRESSED AIR



NIAGARA
AERO
AFTER-COOLER
U. S. Patent Nos.
2,321,933 and
2,296,946
Other Patents Pending

● Controlled temperature cooling with the NIAGARA *AERO* AFTER-COOLER has been the answer to excess water and oil in compressed air lines, preventing spoilage of material when compressed air is used in process and preventing damage to pneumatic tools. No refrigeration is required.

The NIAGARA *AERO* AFTER-COOLER both condenses the moisture before it gets into the lines and also provides jacket water of the proper temperature to prevent condensation in the compressor, washing out the lubricating oil.

It helps produce compressed air containing only ½ to ¾ as much moisture as air cooled by conventional equipment. At the same time it saves 95% of the cost of cooling water, pays for itself in a short time. Write for complete information.

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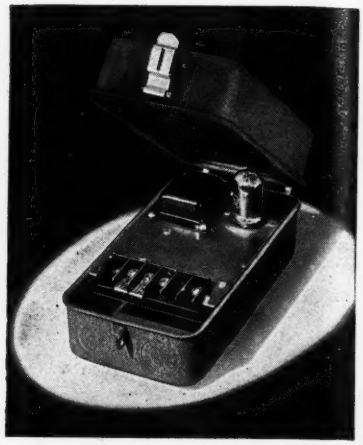
NIAGARA

INDUSTRIAL COOLING • HEATING • DRYING
HUMIDIFYING • AIR ENGINEERING *EQUIPMENT*

within an open or closed tank, bin, hopper or other container. It indicates the level by signals or can be installed to operate solenoid or motor-driven valves, pumps, lights, bells, or other electrical devices.

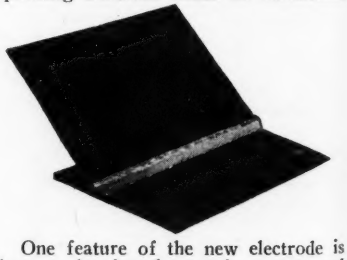


The control itself is non-mechanical. It has no moving parts, and has no chemical or other effect on liquids or solids being controlled. It can be installed in evaporators, freezers, boilers, or other containers involving extreme temperatures; and can be used for controlling the levels of metal chips, acids, brines, chemicals, oil, water, and hundreds of other substances. Various combinations of single and double electrode installations are available.

General Purpose ac-dc Electrode

LINCOLN ELECTRIC Co., Cleveland, O., has announced a new general purpose arc welding electrode for welding mild steel in all positions, with either alternating or direct current.

"Fleetweld 37," the designation given the new electrode, was originally designed as an easy striking, unusually smooth operating electrode primarily for light gage material. Extensive use in production has also shown it to be a fast operating electrode under all conditions.



One feature of the new electrode is that no slag interference is encountered when welding vertical down. For this reason excellent results are achieved in this position, the one in which greatest welding speeds on 8 to 16 gage steel are obtained.

The ability of "Fleetweld 37" to withstand higher currents, both alternating and direct, makes possible higher welding speeds than normal and its easy handling characteristics in all positions make it an ideal electrode for general purpose work. The fact that with proper currents it will neither stick to the work nor burn through makes the electrode especially desirable for light gage welding.

Complete OIC Valve Service

OIC complete Steel, Iron and Bronze Valve service is as near to you as your nearest OIC Distributor. It's a service supported by sixty years of experience and Valve specialization.

There is an OIC ***Distributor Near You. Call him or write to us for complete information on*** OIC ***Steel Valves.***

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THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883

The FRAHM VIBRATING-REED HAND TACHOMETER requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine with which the instrument is held in contact.

This principle and the method of indication are unique among speed measuring instruments. The Frahm Tachometer is as accurate as it is simple, with no parts to wear, adjust, lubricate or renew. It can be used in any position and will give years of trouble-free service. For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 to 30,000 r.p.m.

For a complete description of Frahm Tachometers together with lists of types and ranges commonly supplied, write for Bulletin 1710-PE.

The JONES HEAVY DUTY HAND TACHOMETER is used for indicating r.p.m. and surface speeds of all types of machinery in which the moving parts are readily accessible. Simple, rugged and reliable, it is built to maintain accuracy in hard, everyday service. Scale has equal divisions throughout the 360 degrees of pointer deflection. The instrument can be operated in either direction of rotation and in any position. Single and triple range models up to 12,000 r.p.m. supplied complete with carrying case and accessories.

Write for descriptive Bulletin 1710-PE.

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

"Fleetweld 37" has the following physical properties: tensile strength, 70,000 to 80,000 psi; yield strength, 60,000 to 68,000 psi; and ductility (El. in 2 in.), 18 to 25 per cent.

Level-Lift Sling for 3 and 6 Ton Loads

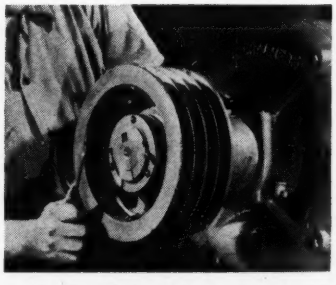
THE NEW SLING shown in the illustration has recently been developed to include a special patented feature that enables the rope to equalize itself and lift unbalanced loads level. Known as

the Type C S E Sling, a single unit is fabricated to handle 3 or 6 ton loads and a double unit 6 or 12 ton loads with a safety factor of 5. The manufacturer states it has been particularly useful in handling long pipes, boxes, steel, and flasks. It is manufactured by Macwhyte Co., 2959 Fourteenth Ave., Kenosha, Wisconsin.

V-Belt Sheave

ALLIS - CHALMERS MANUFACTURING Co., Milwaukee, Wis., has just announced the development of a new sheave, designed for quick and easy mounting and demounting.

Known as the "Magic-Grip" Sheave, it locks to shaft in one tightening operation. As its tapered split bushing, which accommodates normal shaft tolerances, is drawn further into the sheave, the sheave, bushing and shaft are locked together simultaneously. This positive clamp fit makes sure that the "Magic-Grip" Sheave is centered and secure.



The new design of the "Magic-Grip" permits the sheave to be mounted closer to the motor, thus increasing bearing life by reducing shaft overhang.

The sheave slides on the shaft smoothly and easily because increased tolerance is provided by its tapered split bushing. The complete unit of sheave and bushing comes intact, ready for instant mounting which is done by sliding it to exact position where it lines up with the sheave it is to drive or be driven by, then the three cap screws are tightened. Tapered bushing, sheave and shaft lock together securely in one operation.

To take the sheave off the shaft, remove three cap screws. This frees bushing collar from sheave but does not release clamping action on shaft. Two

IMMUNIZE
against this wartime industrial disease

PLANT PARALYSIS

(downtime due to Failure of Controls)

☆ ☆

DEPEND ON McALEAR and You can depend on your INSTALLATION!

☆ ☆

EACH McALEAR CONTROL is a precision instrument, expertly engineered to *keep on* doing its job. Infinite care is exercised in its production. Machining operations are held to critical tolerances. For leak-proof surfaces, trouble-free mechanisms, and unfailing control over pressure and flow.

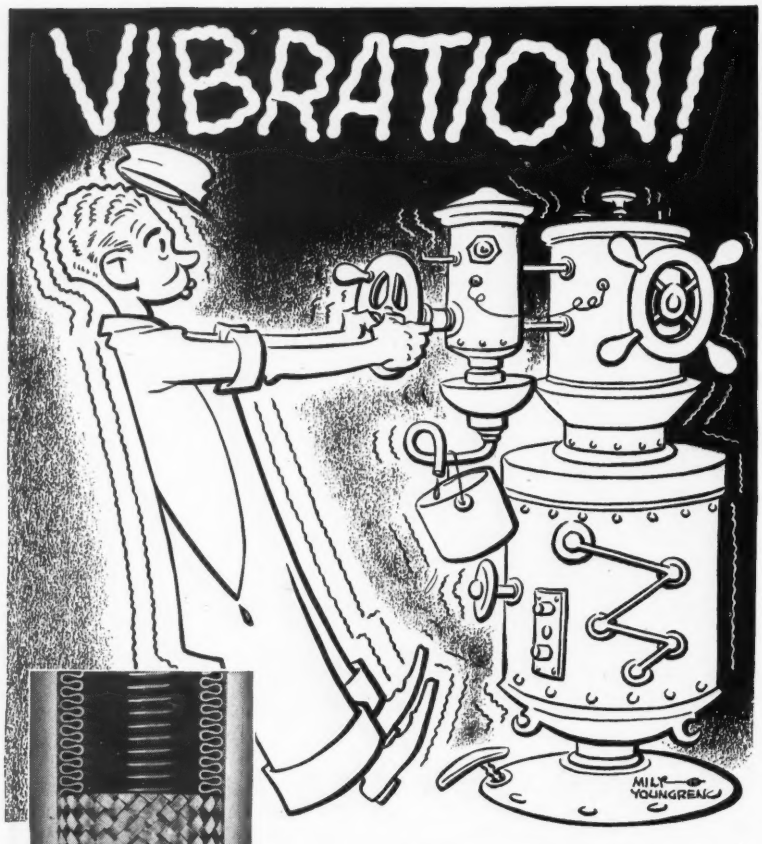
There are 500 McAlear Controls for regulating pressure, temperature and fluid transport. Every one constitutes effective insurance against control failure resulting in plant-paralyzing downtime. Each is engineered for a specific set of working conditions.

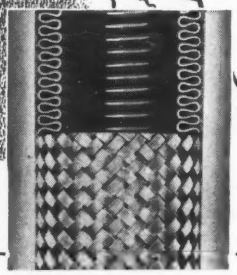
Where *unusual* operating conditions require a special control for steam, water, air, chemicals, oil or gas—McAlear will develop it for you. To keep control costs down—keep up with McAlear.

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL or GAS

IF YOU HAVE A CONTROL PROBLEM . . .

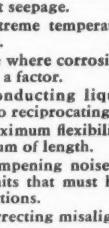
Call on McAlear Engineers. Draw on their fund of experience and readiness to help you, whether for wartime application or post war planning. For informative bulletins and catalog, write McAlear Manufacturing Company, 1915 South Western Avenue, Chicago 8, Illinois.





OUR ENGINEERS will recommend the type of flexible tubing most adaptable to these uses—

1. For conducting liquids from a vibrating to a stationary medium.
2. For high fatigue resistance under constant vibration.
3. For handling searching liquids without seepage.
4. For extreme temperature conditions.
5. For use where corrosion resistance is a factor.
6. For conducting liquids and gases to reciprocating parts.
7. For maximum flexibility with a minimum of length.
8. For dampening noise between two units that must have pipe connections.
9. For correcting misalignment.



REX-WELD Flexible Metal Hose CONTROLS IT

Chicago Metal Hose Corporation's REX-WELD is highly resistant to fatigue even when subjected to constant vibration over long periods of time. It is extremely flexible and remains airtight and leakproof after years of hard usage. It stands up under high temperature and prolonged flexing. REX-WELD is fabricated from strip metal and is precision autogenous welded to form a weld stronger than the tube itself. Write, giving complete information and we will be glad to furnish engineering recommendations for any design problem.

Flexible Metal Hose for Every Industrial Use

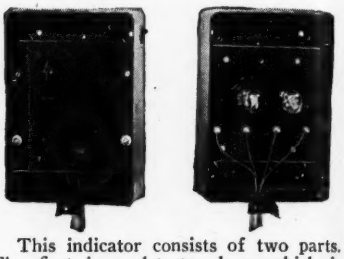
CMH
CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

of the cap screws are therefore used as jack screws. They are inserted into tapped holes in the bushing collar. When the two jack screws are turned, the bushing is separated from sheave. As the bushing is released, it regains natural expansion, automatically breaking its grip of bushing on shaft.

Bin Level Indicator

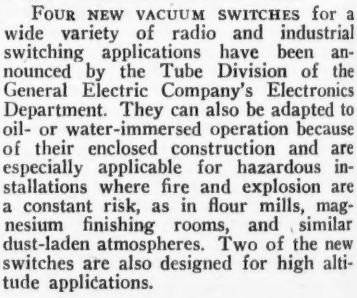
A DRY MATERIALS bin level indicator that employs the electronic principle is now available through Mosher Electronic Control Systems, 130 West 42nd Street, New York 18, N. Y. The device is effective in indicating all types of material, whether fine or coarse.



This indicator consists of two parts. The first is a detector box, which is attached to a probe extending into the bin. In the box are a series of vacuum tubes. A second box is the signal control which is attached to a series of colored lights that show when the bin is full, or empty, etc. Hook-up with valve cut-offs, sound makers, or remote signal devices can readily be arranged through a series of appropriate relays.

New Vacuum Switches

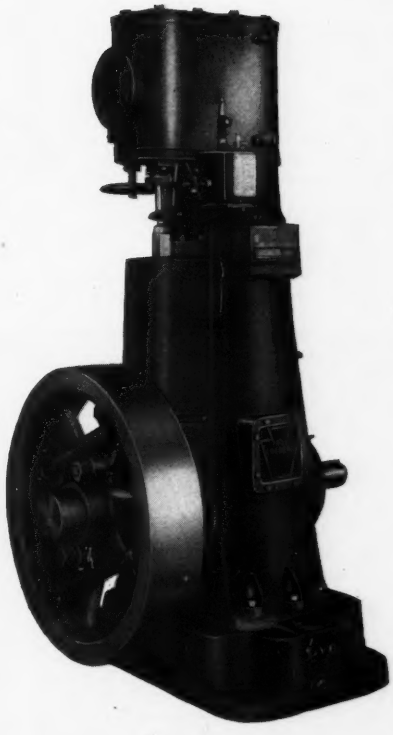
FOUR NEW VACUUM SWITCHES for a wide variety of radio and industrial switching applications have been announced by the Tube Division of the General Electric Company's Electronics Department. They can also be adapted to oil- or water-immersed operation because of their enclosed construction and are especially applicable for hazardous installations where fire and explosion are a constant risk, as in flour mills, magnesium finishing rooms, and similar dust-laden atmospheres. Two of the new switches are also designed for high altitude applications.



Since the contacts of the switches are mounted in a vacuum, they are relatively free from the effects of corrosion and arcing, and are unaffected by dirt or oxidation. The vacuum-type construction also gives the switches a high current rating for their size and permits them to handle enough power to operate equipment at greatly reduced voltages.

Movement is obtained from the mechanism to be controlled, or from other apparatus to suit the application. This

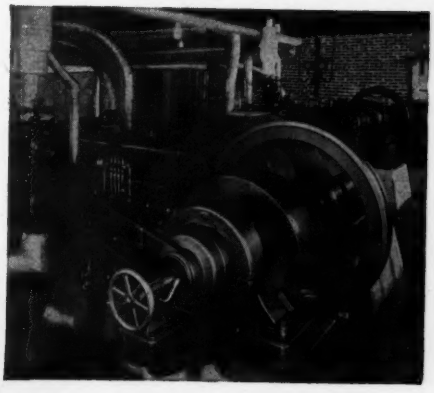
HERE IT IS !



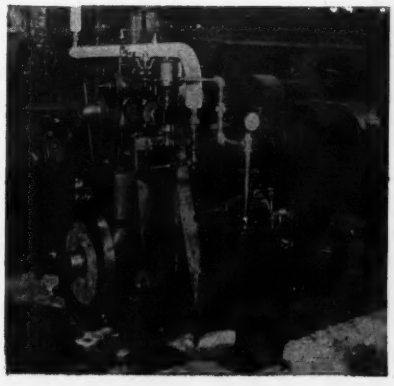
...One of the Most Economical and Dependable of Drives

However you look upon the economics of a drive—cost per kwh, return on investment, pay-off period . . . you will find that the modern Troy-Engberg Steam Engine rates up with any drive. If the plant heat balances are right, it will rate ahead of any other drive.

As for dependability, that of the steam engine cannot be surpassed by any other. Its very simplicity, ruggedness and relatively low speed are factors. That it is correctly designed and carefully made also contributes to its dependability.



In countless factories and aboard ships of all classes, thousands of Troy-Engberg Steam Engines are driving such equipment as stokers, compressors, fans, generators, blowers, pumps, cookers, and dryers. With a range up to 450 hp (Duplex) and a choice of vertical or horizontal types, there's a Troy-Engberg Steam Engine that is just right for almost *any* auxiliary drive.



Right now we are busy making D. C. Generating Sets — yes, we make them, too — for the Maritime Commission. However, look over your drives and check places where you might use a Troy-Engberg Engine to advantage. Plan to use live steam for power and the exhaust for processing or heating.

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movement can often be provided by a slow-moving cam or by the movement of a thermostat, as in air-conditioning or refrigerating equipment. Air or liquid bellows, a rod-linkage system, or almost any other means can be used to operate switches of this type.

An external fulcrum is eliminated by the use of a flexible diaphragm which transmits movement to the contacts and acts as a natural fulcrum point for the operating arm. The contacts close without vibration, making it possible to mount these switches on instruments.

Chemical Treatment of Coal Storage Piles

SERIOUS PROBLEMS, both physical and economic, involved in the storing of coal in stock piles, at public utility and industrial plants, can be easily solved by a new chemical treatment, according to George A. Mau, vice president and chief engineer of the Johnson-March Corp. Those problems to which he referred are the prevention of coal dust nuisance and the inevitable complaints, windage loss (which also means tonnage loss), moisture infiltration and air penetration, which causes "hot spots."

A highly concentrated chemical compound, designed to wet rapidly all types of carbonaceous and siliceous dusts, has been developed by the research laboratory of The Johnson-March Corp. This product, which is known by the trade name Compound 100, not only prevents coal dust nuisance and windage loss by rapid wetting, but forms a closely knitted bond, or air and moisture resistant media, due to consolidation, packing and interlocking of fine coal particles. This closely knitted strata of interlocking particles also acts as a water shed and consequently drains surface moisture away quickly.

When applied to the surface of coal storage piles, the depth of penetration of the solution is limited by the fineness of the coal, or the increased surface areas. The finer the coal particle, the less the penetration, and the nearer the surface the protective media is formed.

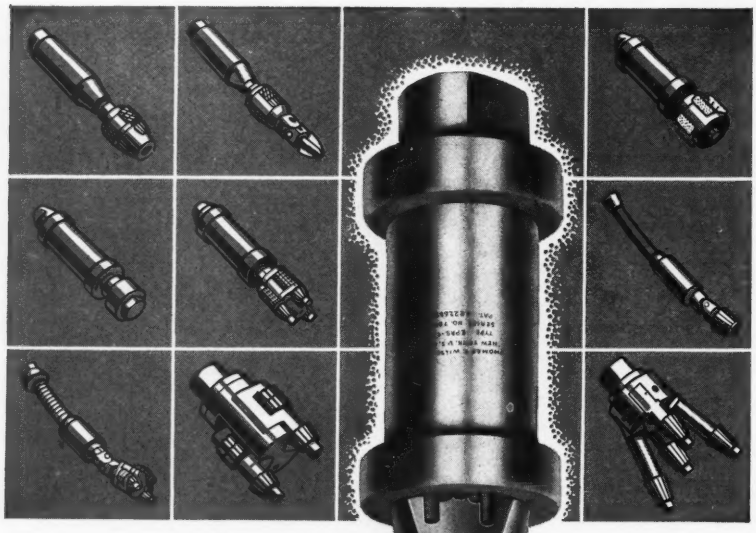
For treating coal stock piles of 10,000 tons or over, it is recommended that orchard spray equipment be used to apply Compound 100 solution. The spraying equipment consists of a high pressure (300-500 psi) pump, mixing and agitator tank (500 to 1000 gal capacity), spray gun with wide angle nozzle and hose from 250 to 600 ft length.

This type of equipment was recently used at a public utility plant to treat 200,000 tons of coal. The time required to treat this tonnage storage pile was about 22 hr.

For treatment on smaller tonnage stock piles, the application can be made with standard ¾ in. garden hose, using a syphonette for proportioning and mixing the compound concentrate with water. The syphonette can be mounted on end of hose with the suction tubing drawing the concentrate chemical from a pail.

Compound 100 solution can be applied at any time, even during light rain storms, excepting freezing weather. The spraying solution, which contains only 2 per cent of the concentrated chemicals, will obviously freeze at the same temperature as ordinary water.

This solution can also be used to control dust while unloading the coal from cars, hauling or conveying to plant bins and storage piles. The method recommended is to spray the coal as it is moved from car pocket to conveyor by placing spray near the bottom of conveyor, directed so that the spray partly covers the coal flowing from the pocket and partly as it drops to the conveyor. The ¾ in. syphon with nozzle for automatically mixing the compound with water is very effective for this application.



WILSON TUBE CLEANERS

EP (Extra Power) Air or Steam Motor With HSC Cutter Head.

With a wide variety of cutter heads, vibrating heads, vibrators, drill heads and brushes . . . for every conceivable kind of tube- or pipe-deposit.

Modern tube-cleaners for the problems of today.

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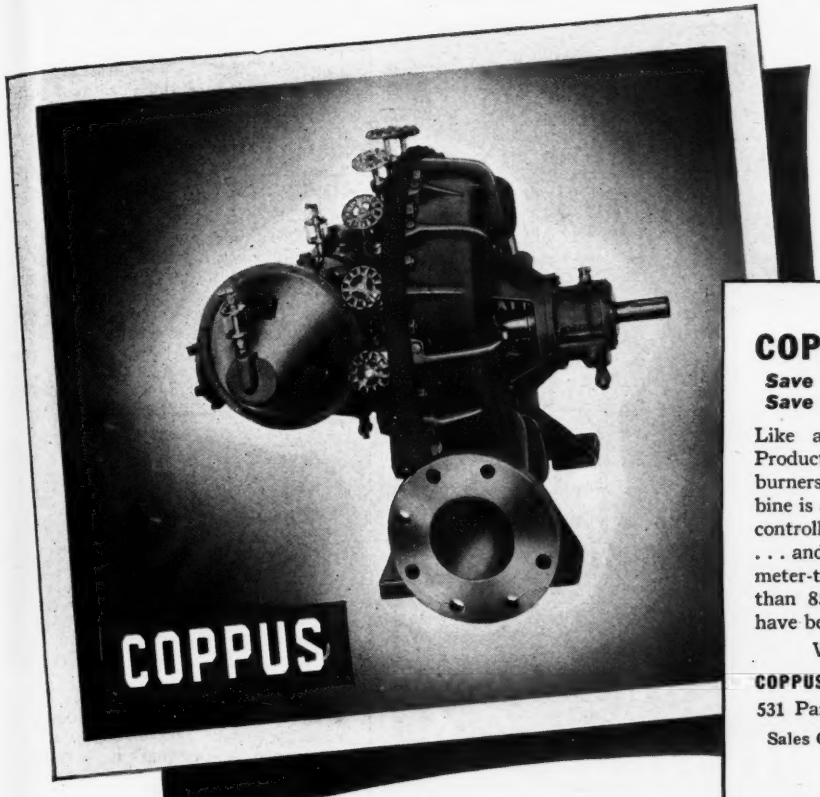

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Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the Coppus steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. More than 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

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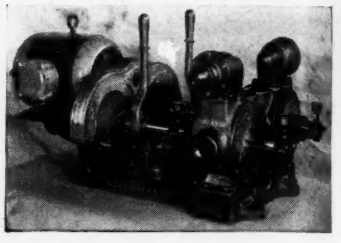
For large coal tonnages, as handled in public utility plant conveyor systems, other methods of application and a more concentrated chemical have proven very successful in allaying floating dust in conveyor galleries, boiler rooms, and similar service.

Twin Pumping Unit

BLACKMER PUMP CO., Grand Rapids, Mich., has developed a new twin pumping unit which has a capacity of 90 gpm for pressures up to 100 psi and is mounted on a substantial cast-iron base. A single 1800 rpm motor serves as a driver through a reduction gearing. The operation of the unit is controlled by newly designed twin clutches. The pumps making up the unit may be operated singly or together.



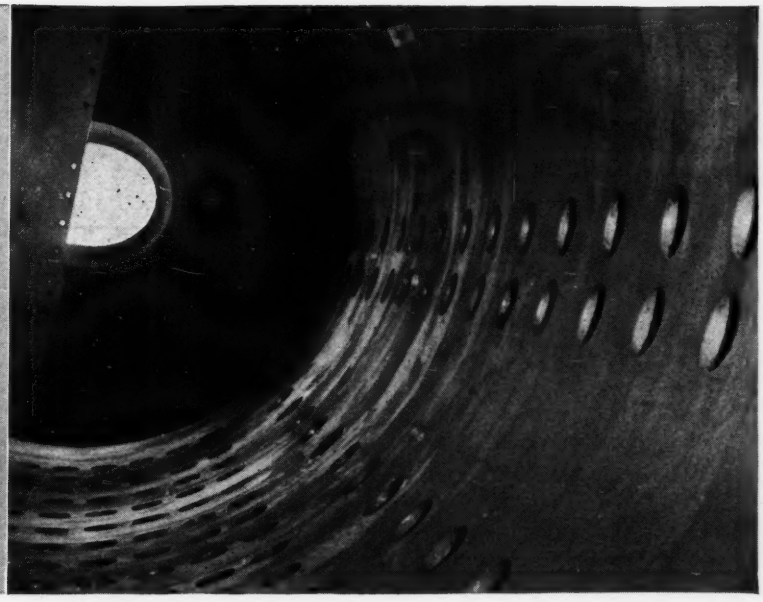
The chief advantage of this unit appears in the fact that it provides double capacity to take care of temporary peak requirements, or that it permits the handling of two different liquids without contamination. The pumps operate on the "bucket design" (swinging vane) principle and are furnished in three constructions: unlined, with removable liners for handling corrosive or abrasive liquids, or the pumps may be furnished with steam-jacketed heads for pumping highly viscous liquids, or materials that are solid at room temperatures.

New Turbine Blade

FOUR YEARS AGO Westinghouse engineers began studies of turbine impulse blades which have now been completed. The middle 30's saw the size of high-speed (3600-rpm) steam turbines, designed for superposition over existing units in power houses, being rapidly increased. In three years the largest size of this type was extended from about 15,000 to approximately 50,000 kw. Steam engineers, in crossing these new frontiers, found themselves faced with new conditions. Impulse blades made correspondingly stronger, according to previous practice, were not strong enough. The established design rules no longer held in these new regions of temperature, pressure, and vibration.

To carry out a program of theoretical and laboratory studies, a special test turbine was built and a unique scheme was devised for taking photographic records of blade behavior with the turbine in actual operation. In this four-year study several types of blades have been tested using a wide variety of temperatures, loads, and speeds. Long endurance runs have been made and about 120,000 photographic records were taken on about six miles of film.

These investigations have resulted in the design of a simple impulse blade which is fastened to the turbine rotor by a root shaped like an inverted U. Three of these blades are brazed together, forming one solid segment. Each three-



Scrap?... Reduce Pressure? ...No, APEXIORIZE!

APEXIOR GIVES BOILER METAL YEARS OF EXTRA SERVICE

Looks, fortunately, are often deceiving. Boilers that appear to be ready for the scrap pile or for operation at reduced pressure, have often been restored to good operating condition by APEXIOR. If they can pass inspection and a hydrostatic test, this long-lasting, corrosion-resistant, scale-resistant covering will "peg" that condition for more years of good performance.

APEXIOR seals up the pores and joints. It is applied with a hand brush or power coater after cleaning down to bare metal. One application lasts 2 to 3 years, and is easily renewed when worn too thin for protection. APEXIOR takes the wear . . . not the metal.

RECOMMENDED BY BOILER INSURANCE COMPANIES

Painting boiler metal is recommended by boiler insurance companies. Hundreds of industrial power plants, utilities, railroads and marine operators have been following their suggestions. And manufacturers of turbines coat shafts, rotor bodies and frequently interiors of casings with APEXIOR to lengthen the life of the metal and to facilitate its periodic cleaning.

So, before you start worrying about how to replace your aged equipment, have it tested . . . then APEXIORIZE if it passes the examination.

APEXIOR is a safe, sure answer to lack of new equipment . . . the solution to your problem of getting more out of your present equipment.

Save metal . . . extend time between boiler cleaning . . . make cleaning easier . . . APEXIORIZE.

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It will help you get more service from irreplaceable equipment

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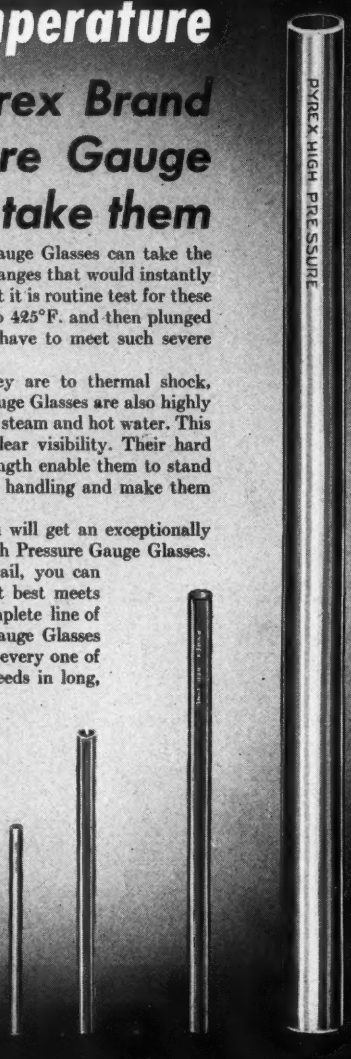
Extreme Temperature Shocks? Pyrex Brand High Pressure Gauge Glasses can take them

PYREX brand High Pressure Gauge Glasses can take the shock of sudden temperature changes that would instantly shatter an ordinary glass. In fact it is routine test for these gauge glasses to be heated up to 425°F. and then plunged into ice water. Will they ever have to meet such severe tests in your service?

And just as resistant as they are to thermal shock, PYREX brand High Pressure Gauge Glasses are also highly resistive to the solvent action of steam and hot water. This means that they retain their clear visibility. Their hard smooth surface and rugged strength enable them to stand up better under rough physical handling and make them less liable to become scratched.

Yes, you can expect and you will get an exceptionally long life from PYREX brand High Pressure Gauge Glasses.

Where other conditions prevail, you can select the right gauge glass that best meets your requirements from the complete line of PYREX and CORNING brand Gauge Glasses listed below. You will find that every one of them will fill your particular needs in long, value-giving service.



PYREX brand High Pressure—resistant to thermal and mechanical shock and attack of steam and hot water. Machine drawn accuracy.

PYREX brand Red Line—Same but with added visibility afforded by enameled red line.

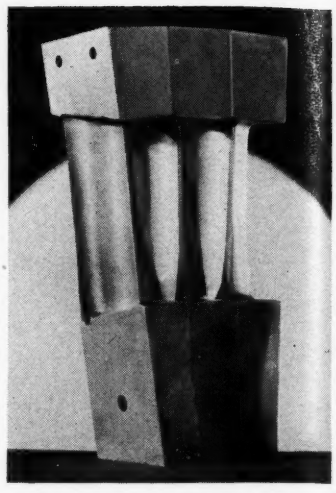
PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.

Corning Standard—For moderate pressures. Long lasting.

"Pyrex" and "Corning" are registered trade-marks and indicate manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

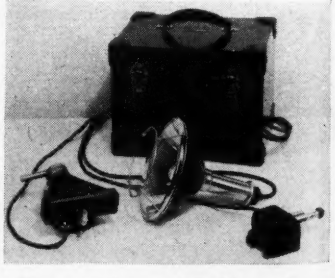


blade segment is fastened to the rotor by two crosswise pins.

The new blade is smaller than the old one, 1½ in. wide instead of 2. Not only that, old design blades, which are larger, failed in less than 20 hr—the new blades pass a life test of 1000 hr with no indication of weakening. Experience shows that if a blade fails at all, it will do so in a relatively few hours. Fortified with a great deal of new design information about impulse blades, turbine engineers are ready to move to new levels in turbine construction when the central-station industry needs, and is able to obtain, larger, more powerful, high-speed units.

Dynamic Balancing Instrument

IMPROVEMENT in the Davey Portable Balancing Equipment for dynamic balancing of machine parts has been announced by The Vibroscope Co., 6 E. 39th St., New York 16, N. Y. This equipment consists of a vibrometer which measures vibration amplitude directly and a stroboscope which gives a direct visual reading of high spot or phase angle. Its purpose is to locate the positions and magnitudes of weights required to correct unbalance in machines of any size and any speed.



The new feature of this equipment, which is applicable to machine parts of all sizes in their own bearings or in bearings built for the purpose, is a remote control switch mounted on the vibrometer which places the entire operation in the hands of a single operator, instead of adjustments being made by a second operator, as in earlier models.

In the new design, simplicity of construction and operation have been retained so that balancing may be per-

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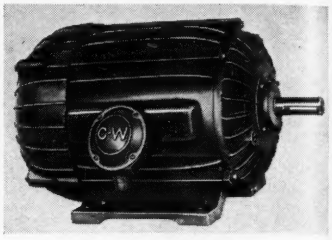
formed by practical men and theoretical knowledge is not required to interpret the results. The two models available weigh respectively 22 and 25 lb complete in portable case with batteries.

Corrosion-Resistant Motor

THE CROCKER-WHEELER DIVISION of the Joshua Hendy Iron Works has recently placed on the market a newly developed corrosion-resistant motor called Sealedpower. This motor is suitable for operation in atmospheres containing injurious dusts, corrosive vapors or gases.



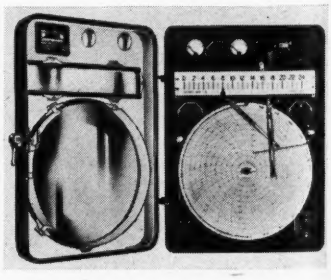
This motor is available in sizes from one to fifteen horsepower and can be furnished for operation from any polyphase power supply.

In construction the Sealedpower motor is of the totally enclosed, fan cooled type, but the design departs from previous models in that there are no cooling ducts to become fouled with wet or sticky dusts. All exposed parts of the corrosion-resistant model are acid and alkaline resistant to a high degree.

In addition to the mechanical sealing of the entire motor, each coil is individually sealed against moisture, fumes, vapor and dust by the vacuum impregnation process.

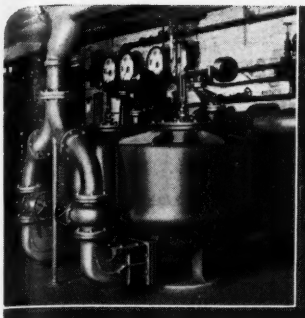
Self-Balancing Potentiometer

THE NEW MODEL 431 Pyromaster Self-Balancing Potentiometer announced by The Bristol Co., Waterbury, Conn., has a universal wall or flush mounting case that is considerably deeper than the previous Model 440M, and has an internal hinged panel on which are mounted pen and indicator drive mechanism, and, in the case of electric controllers, the control contacts or proportioning slide wire, or in the case of air control, the complete new convertible-type air operated control mechanism.



This new deep case and inner panel make it possible to service or replace any part or portion of the instrument without disturbing any other part. It also makes it possible, in the case of electric type controllers, to include the control relays in the instrument, thus eliminating considerable external wiring.

A heavy-duty pen-drive motor gives



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- Mellon National
- Woolworth

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Resolve now to stop taking chances. Fit all water columns with SONDERGLASS, either *Clear* or *Reflecting* type. Its double-strength construction brings added safety to boiler room operation. And it resists clouding or discoloration no matter how long it is in service.

Genuine SONDERGLASS, which thousands of engineers know as "The Unbreakable Gauge Glass" may be ordered from your steam supply man or directly from us. We also manufacture the complete line of Chesterton Mechanical Packings.

Tested for SHOCK Resistance!

In repeated tests SONDERGLASSES have been dipped in hot oil 450 deg. F., then quickly plunged in cold water without breaking.

A. W. CHESTERTON COMPANY
64 India Street, Boston, Mass.
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SONDERGLASS

OPPORTUNITY

Boiler Feed Water Men

Exceptional Opportunity For Experienced men. Chemical or Mechanical background. Permanent Post-War Program, Good Salaries and Advancement. Principal Industrial Cities.

Address Box No. 1432, Power Plant Engineering, 420 Lexington Ave., New York 17, N. Y.

more torque for operating control contacts and other similar functions, especially under conditions of poor line voltage regulation.

The stepping relays and the slide wire in the potentiometer circuit have been enclosed in a dust-proof bakelite housing, and a heavier power supply has been provided.

Another change is that a standard cell type of manual standardizing circuit now replaces the voltmeter type originally supplied.

The Model 431 Pyromaster uses the same basic principle as previous models, providing a self-balancing round-chart recording potentiometer that has no continuously moving mechanical elements, is unaffected by vibration, and needs no lubrication.

OBITUARIES

William G. Irwin

WILLIAM G. IRWIN, chairman of the Board of Directors and founder of the Cummins Engine Co., Columbus, Ind., died suddenly on December 14 in Indianapolis, Ind. He was 77 years old. Mr. Irwin was well known in industrial circles and was one of the important figures in the development of this country's Diesel engine industry.

E. F. Whitney

ERLE F. WHITNEY, assistant district manager of the General Electric Co.'s East Central District for the past 14 years, died in Cleveland, Ohio, on December 12 following an illness of several months.

Mr. Whitney was a native of Bleakhouse Plantation, Miss., and had been associated with the company since 1907 when he was graduated from the Massachusetts Institute of Technology. During World War I he was a captain with the 29th Engineers overseas.

Before coming to Cleveland in 1929 to assume the position which he held until his death, Mr. Whitney was manager of the General Electric office in Portland, Ore., for six years.

MANUFACTURERS' PERSONALS

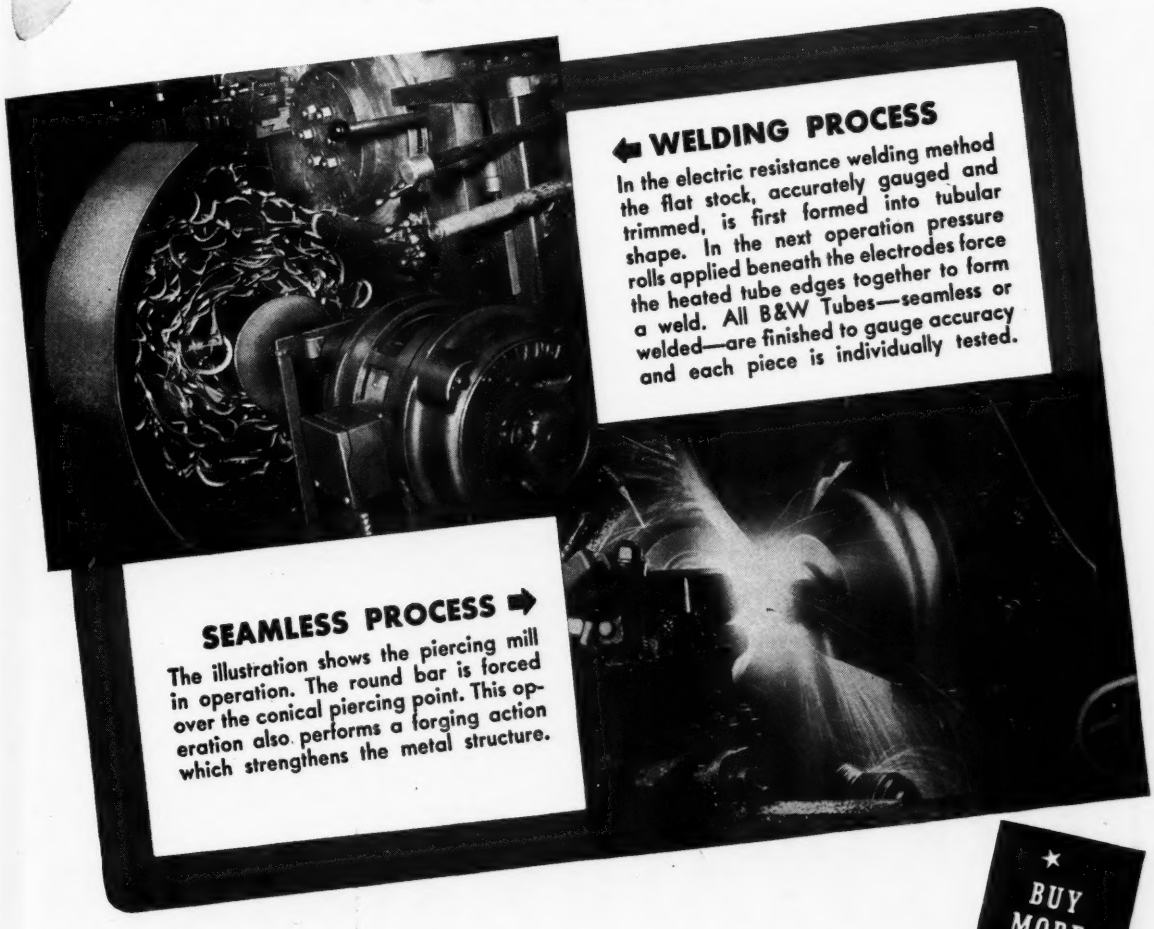
The Philadelphia Gear Works has announced the following organization changes: James N. Morrell became Sales Manager — Limitorque Valve Control Division of Philadelphia Gear Works, Philadelphia, Pa. Thomas V. Withington relinquished his position as Chief Engineer to become Assistant Sales Manager—Limitorque Division. William F. Plume succeeded Mr. Withington as Chief Engineer. Robert E. Richards is appointed Assistant Chief Engineer. All have been associated with the company for some time.

The appointment of James H. Jewell as assistant manager of industry departments has been announced by the Westinghouse Electric & Mfg. Co. Mr. Jewell, manager of the company's agency and specialties department since 1940, will continue to head that division. In his new position Mr. Jewell will supervise all activities of the industry departments except applica-

Seamless or Welded

IT'S THE STANDARD B&W QUALITY

The use of quality steel in the manufacture of Babcock & Wilcox Boiler Tubes—whether seamless or welded—is of major importance in this day of high-pressure, high-temperature boiler installations. Seamless tubes are produced by a piercing operation which also includes a forging action. The electric resistance method welds flat stock into tubes of uniform wall thickness, maximum strength and excellent finish. These characteristics of all B&W Tubes are your guarantee of SAFETY.



⬅ WELDING PROCESS

In the electric resistance welding method the flat stock, accurately gauged and trimmed, is first formed into tubular shape. In the next operation pressure rolls applied beneath the electrodes force the heated tube edges together to form a weld. All B&W Tubes—seamless or welded—are finished to gauge accuracy and each piece is individually tested.

SEAMLESS PROCESS ➡

The illustration shows the piercing mill in operation. The round bar is forced over the conical piercing point. This operation also performs a forging action which strengthens the metal structure.

★ BUY MORE WAR BONDS! ★

THE BABCOCK & WILCOX TUBE CO.

SEAMLESS TUBE DIVISION • *WELDED TUBE DIVISION*

BEAVER FALLS, PA. **ALLIANCE, OHIO**

TA-1274

Use this STEAM TRAP GUIDE *in making postwar equipment plans*

Every sign points to a vital need for more economical postwar production. In considering plans for new steam using equipment, remember that more economical production can be attained through selecting the right steam trap for that equipment.

In making recommendation for new steam using equipment and traps, use the book, "How to Choose a Steam Trap," as a guide. It shows you how to select the right steam trap for economical production from steam using units. It also describes SUPER-SILVER-TOP STEAM TRAPS, noted for their savings in fittings, time and work, because they can be installed as an elbow or straight-in-line. To help you with your postwar plans, we will gladly send you a copy.

THE V. D. ANDERSON COMPANY
1939 West 96th Street • Cleveland 2, Ohio

BACK THE ATTACK WITH WAR BONDS

tion data and training and general contract, which will report direct to F. H. Stohr.

The Engineer Company announces the appointment of George J. Zanke as District Manager in charge of sales for the Chicago territory. Mr. Zanke will be located at the same address, 330 South Wells Street, Chicago 6, Ill.

James A. Dwyer has been appointed general manager of sales and branches of Crane Co. with headquarters in Chicago. Since 1917 when Mr. Dwyer joined the Crane organization, he has been successively estimator, salesman, chief clerk, branch sales manager, assistant branch manager, branch manager, and district manager. About a year ago he was made manager of branch houses, which responsibilities he will continue to assume in addition to his new duties as general manager of sales.

Ralph H. Heberling, for the past two years assistant to the president in charge of manufacturing, on Jan. 1, 1944, became vice-president of The Edward Valve & Mfg. Co., Inc., East Chicago, Ind. Mr. Heberling will continue to supervise all manufacturing activities of the company.

Leon R. Ludwig, formerly head of the company's circuit breaker and protective devices division, has been named manager of the motor division of the Westinghouse Electric & Mfg. Co. Mr. Ludwig worked with Dr. Joseph Slepian, associate director of the Westinghouse Research Laboratories, to develop the Ignitron, a power tube which converts alternating current into direct current. He succeeds R. W. Owens, resigned.

Fred G. Stebbins has been appointed manager sales, capacitor section, and Edward V. Dillon is assistant manager sales, feeder voltage regulators, in the Transformer Division of the Central Station Divisions, General Electric Company. Mr. Stebbins succeeds Charles F. Miller who will be senior transformer specialist for the New York District. Mr. Dillon's position has just been created.

E. Russell Bassett on January 10 assumed his duties as manager of sales of the McClave Co. for the central Pennsylvania sales territory, with headquarters at the main office, 751 Mill Street, Allentown, Pa.

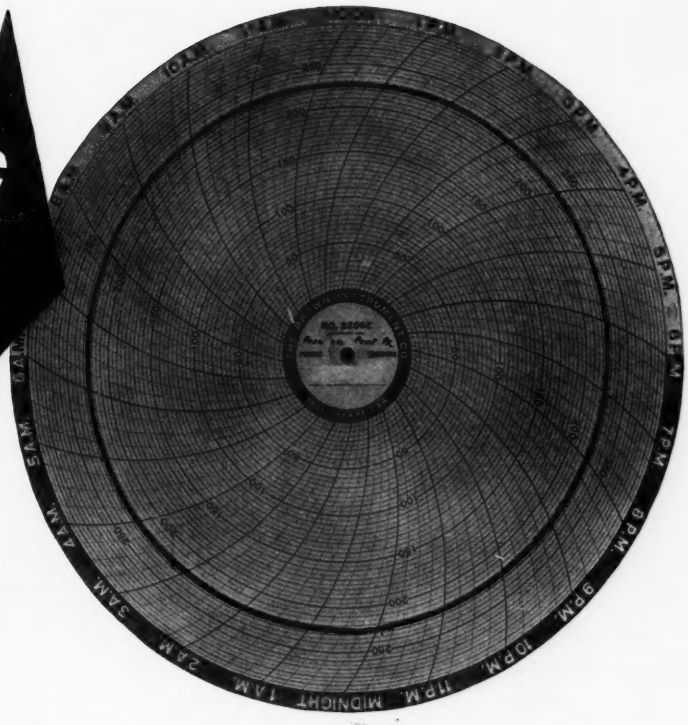
Ford Brown, assistant manager of the Blackmer Pump Co., Milwaukee Office, was transferred to Minneapolis, January 1, and now is in charge of pump and accessory sales in Minnesota, North and South Dakota and Northern Wisconsin.

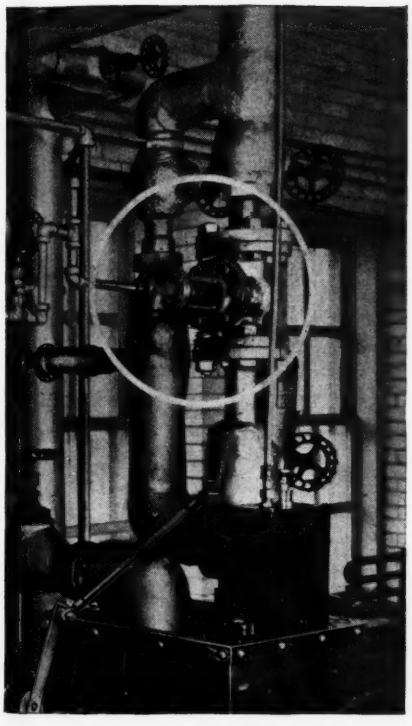
R. C. Hardy has been appointed district manager of General Electric's Central Station division, Cleveland, Ohio. Mr. Hardy succeeds the late Erle F. Whitney, who had been manager for 14 years.

Roy E. Ward, district manager of The Austin Co. at Los Angeles since 1925, and Frank W. Maynard, the company's district manager at Oakland, Calif., since 1937, have been named vice-presidents of this organization.

W. S. Richardson, general manager of the chemicals division of The B. F. Goodrich Co., Akron, O., has been elected vice-president of the Hycar Chemical Co., which duties he will carry in addition to those with B. F. Goodrich. Mr. Richardson succeeds Raymond W. Albright who recently resigned to become vice-president and general manager of the Distillation

What's WRONG with this Curve?





Foster Type 38-P6 Pump Governor installation showing proper by-pass arrangement — for full details see Catalog 70.

★ **BUY WAR BONDS** ★

It looks too broad—as though the pen had picked up a piece of fuzz—but that's not *why* it's broad. The answer is, it is actually *SEVEN* curves. Paper is scarce, and each chart, although checked daily, is being used for one week instead of one day.

Still, the curve is *flat*, with *no nicks*, and it shows how closely a nine-year-old Foster 38-P6 Pump Governor is regulating discharge pressure on a duplex fuel oil pump, twenty-four hours a day, seven days a week. Furthermore, charts for other weeks tell an identical story, because this governor is the right size and type for the job, and it was properly installed.

Your problem may be different. If it involves pressure or temperature regulation, however, you can be sure that there's a specific Foster Valve to give you equally satisfactory performance, because there's a Foster Valve for *every* service requirement. And our engineers will be glad to help you get the right valve.

Illustrated catalog on the complete Foster line, with many pages of useful engineering data will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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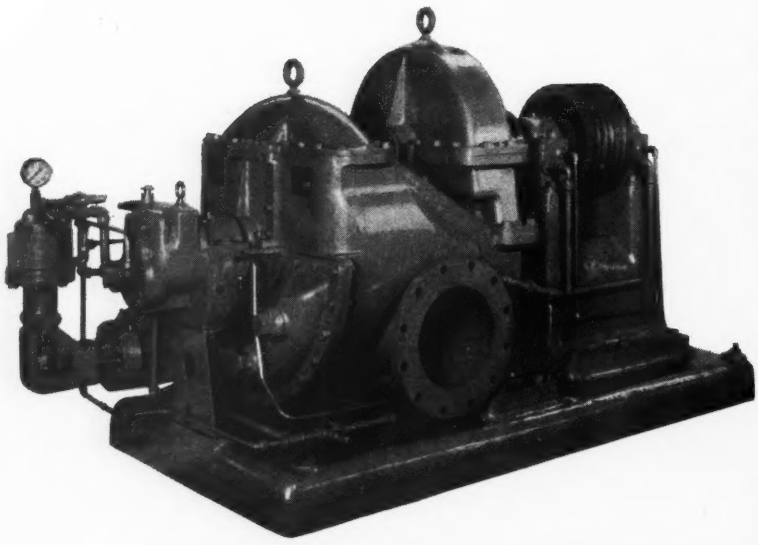
2-FE-2

MURRAY TYPE UG

Integral Geared Turbine



★ **Murray Type "UG" Integral Geared Turbine consists of the Type "U" Mechanical Drive Turbine with integral single or double helical reduction gear. Turbine is supported by the gear at the turbine shaft centerline thereby avoiding misalignment due to the heating of the turbine casing.**

View shows Murray unit equipped with variable speed direct acting oil pump governor, and extended low speed shaft with sheave for V-belt drive. Write for descriptive bulletin.

BOILERS TURBINES ENGINES

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

PAPER PACKS A WAR PUNCH

Fight Waste!

When the store clerk suggests you accept an unwrapped purchase, cheer on the good work. For this is part of a nation-wide drive to save paper, the precious wrapping paper, the precious paperboard needed by our Army and Navy to protect the ammunition, the weapons, the food, the blood plasma which go to our fighting men overseas. Why not join in the drive yourself, help your local merchants to save paper, enlist your family in home paper-saving?

Products, Inc., of Rochester, N. Y. Mr. Richardson entered the rubber industry in 1914 and joined The B. F. Goodrich Co. in 1926 on the staff of the works manager. In 1942 he was made general manager of industrial products and sundries sales division and earlier this year was named to head the company's chemicals division. Hycar Chemical Co., organized in 1940 by the Phillips Petroleum Co. and The B. F. Goodrich Co., engages in the manufacture and sale of synthetic rubbers and is today the largest private producer of butadiene-type synthetic rubber in the United States.

Westinghouse Electric & Mfg. Co. has announced the appointment of Herbert L. Rawlins as manager of the Protective Devices Engineering Department, replacing L. R. Ludwig, whose appointment as manager of the Motor Division was recently announced. Previously Mr. Rawlins was assistant manager of Circuit Breaker and Protective Devices Engineering. Another appointment was that of A. W. Hill, design engineer, who now becomes manager of Power Circuit Breaker Engineering, also part of Mr. Ludwig's former responsibility.

E. A. Green has been named general assistant to the manager of General Electric's motor division, according to a recent announcement. Mr. Green was graduated from Swarthmore College in 1924, and in August of that year he joined General Electric at Schenectady as a student engineer on the company's test course. Since that time he has advanced through successive steps until in September, 1943, he was given special assignments under the supervisor of apparatus production for the company, which position he held at the time of his appointment.

MANUFACTURERS' NEWS

Army-Navy "E" Award

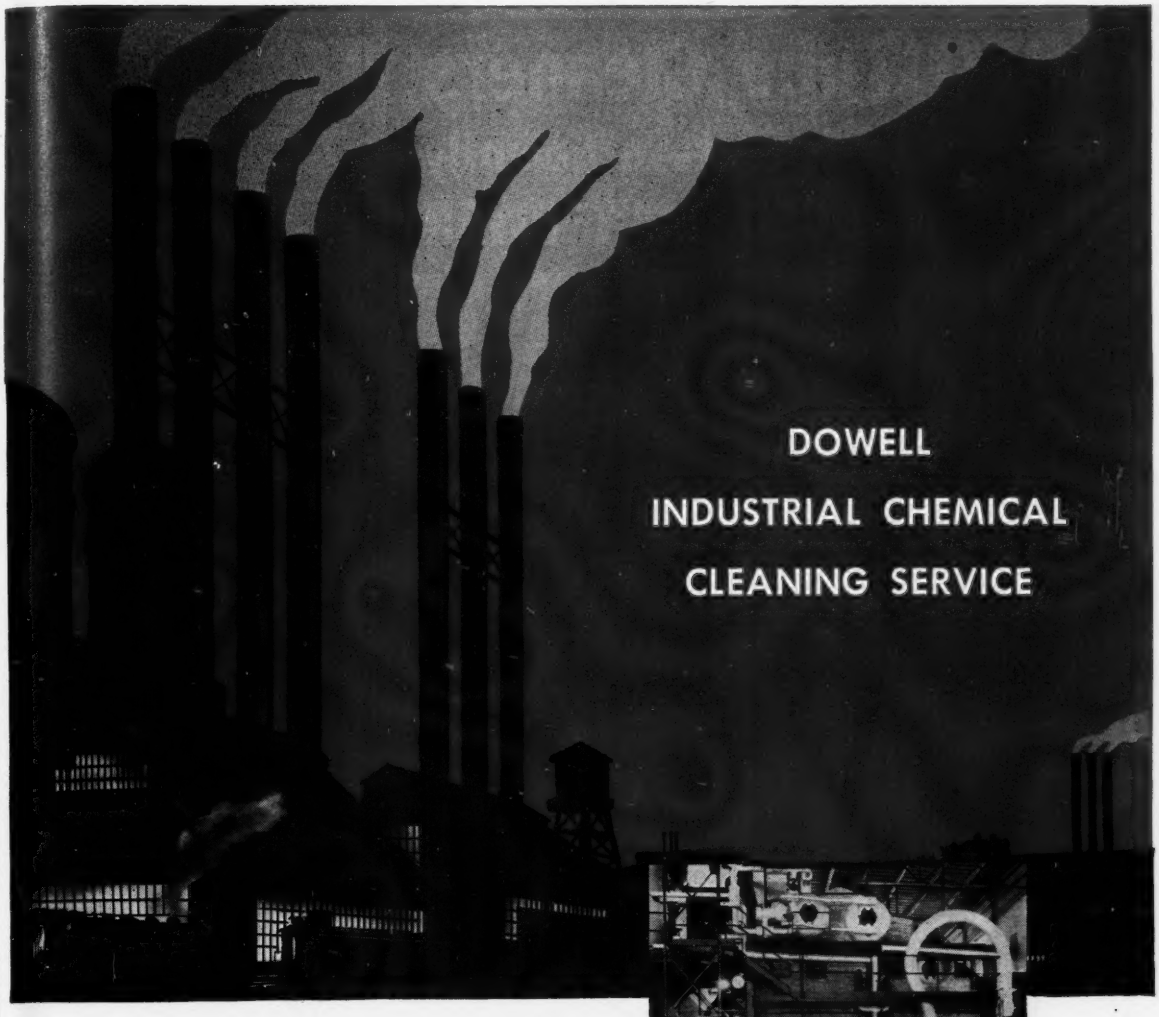
The Babcock & Wilcox Co.*
Barberton Plant
Kennedy-Van Saun Mfg. & Eng. Corp.
Danville, Pa.
The Maxim Silencer Co.*
Hartford, Conn.
H. K. Porter Co., Inc.*
Pittsburgh, Pa.
C. H. Wheeler Mfg. Co.
Philadelphia, Pa.

Maritime Commission "M" Award

Homestead Valve Mfg. Co.*
Coraopolis, Pa.

The Marley Co., Inc., of Kansas City, Kansas, manufacturer of cooling towers and spray nozzles, has established a new divisional office at 2006 Esperson Bldg., Houston, to provide immediate and direct sales and service coverage of the Texas Gulf Coast, Northwestern Louisiana and South-

*Star added for sustained high achievement in production of war equipment.



MAKES POSSIBLE GREATER FUEL ECONOMY

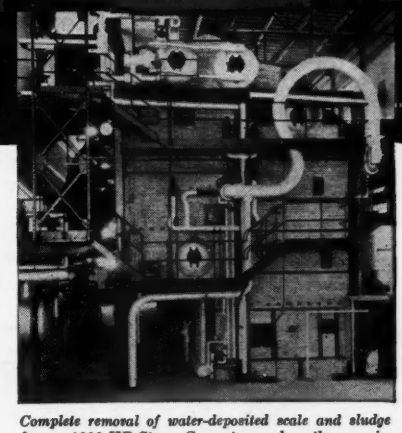
Ever since water was first used as a heat transfer medium, the steam or water-deposited scales and sludges have presented a serious industrial problem. Today, through the application of chemistry, Dowell removes these deposits from heat exchange surfaces in a few hours' time without dismantling the equipment. Important savings in fuel result—down-time is cut to a minimum—efficiency is improved—heat transfer is faster.

The service employs mobile equipment, chemical solutions and trained personnel. It is designed to quickly dissolve and disintegrate most scale and sludge deposits.

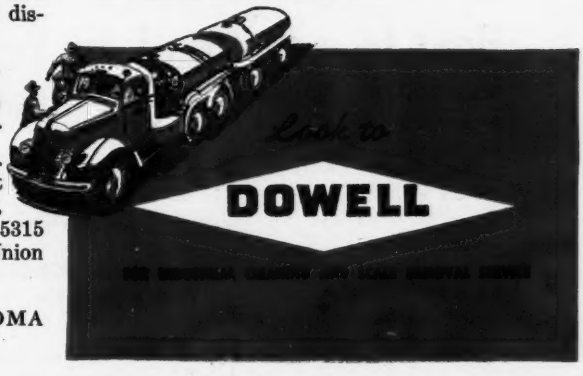
This pioneer chemical service is successful in cleaning many types and all sizes of industrial boilers, cooling jackets, economizers, condensers, feedwater heaters and water lines.

For details write or contact Dowell office in your locality. New York, 30 Rockefeller Plaza; Philadelphia, Girard Trust Bldg.; Cleveland, 2314 Terminal Tower Bldg.; Chicago, 135 So. LaSalle; St. Louis, 2nd and Madison; Houston, 5315 Lawndale Ave.; Kansas City, 3560 Broadway; Wichita, Union National Bank Bldg.; Mt. Pleasant, Mich.; Salem, Ill.

DOWELL INCORPORATED, TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company



Complete removal of water-deposited scale and sludge from a 1000 HP Steam Generator, such as the one pictured here, was accomplished in less than 24 hours with Dowell Industrial Chemical Cleaning Service.



ROTO Tube Cleaners
help you to operate efficiently WITH REDUCED MANPOWER

A great reduction in time and labor required to keep tubular equipment at top efficiency is possible with Roto Tube Cleaners. One-man operation, a Roto feature for many years, enables one man to clean tubes entirely by himself. This labor-saving feature also eliminates the time formerly wasted signalling the helper. A simple air valve on the motor does the job. Roto offers you a wide selection of dependable, powerful tube cleaners for every power plant requirement.

The ROTO Company
145 Sussex Ave., Newark 1, N. J.

OFFICIAL WAR MESSAGE NO. 12

How to say "No" to Yourself

When you're tempted to buy something you don't really *need* . . . remember all the things our boys are going without. It will help *you* go without, too.

When you're tempted to pay more than ceiling prices, or to patronize a black market, or to profit from the war in any way . . . remember the sacrifices our men in uniform are making. It will help *you* make sacrifices, too.

Remember that the only sure way to keep prices down is for you to: use it all, wear it out, make it do, or go without. Pay your debts. Pay your taxes. Buy more bonds and *Smash the Axis!*

western Arkansas. The new office adds its increased facilities to those in Dallas, Corpus Christi, San Antonio and El Paso where the company's representation remains unchanged. Ray T. Jenkins, formerly in charge of the Tulsa divisional office, heads the Houston division. Mr. Jenkins joined the Marley organization in 1933 and represented the company in Dallas for three years before assuming direction of the Tulsa territory in 1937.

The Twenty-Seventh Annual Meeting of the National Association of Fan Manufacturers was held in Detroit, Mich., on January 19, 1944, at which time the following officers were elected for the ensuing year: C. T. Morse, President; J. M. Frank, Vice-President; and L. O. Monroe, Secretary-Treasurer.

Allen-Bradley Co., of Milwaukee, Wis., has recently appointed Rietze & Co., 1017 E. Broadway, Louisville 4, Kentucky, as sales representative for electric controlling apparatus in the southern Indiana and western Kentucky territories.

Kieley & Mueller, Inc., North Bergen, N. J., designers and manufacturers of automatic pressure and level control valves and equipment, has appointed the F. L. Murdock Co., of Tulsa, as exclusive sales representatives for the State of Oklahoma, and Daniel Orifice Fitting Co. of Houston for the States of Texas and Louisiana.

The Lincoln Electric Co. has announced the appointment of R. H. Davies as welding engineering representative in Washington, D. C. He will be located at 410 Hill Building. Mr. Davies is an industrial engineer, having received his college education at the University of Minnesota after which he was employed by The Lockheed Aircraft Corp., later with Northrop Aircraft, Inc., and Henry J. Kaiser.

W. C. Carter, president of Link-Belt Co., Chicago, has announced the election by the Board of Directors, of two vice-presidents, effective Jan. 1, 1944.

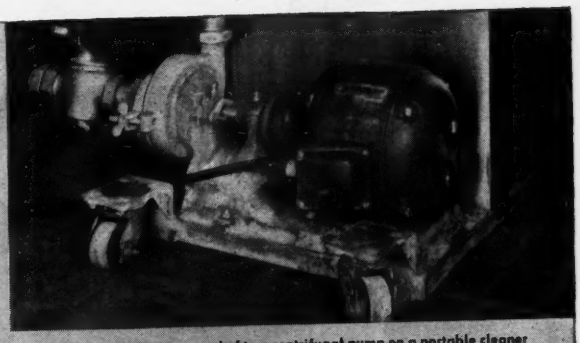
E. L. Berry, vice-president and general manager of Link-Belt Ordnance Co., has been elected vice-president of Link-Belt Co., the parent organization. Mr. Berry, who began his Link-Belt career in 1914, has for many years devoted his time particularly to matters of production and personnel. His new headquarters will be at the company's general office, 307 N. Michigan Ave., Chicago.

Richard F. Bergmann, company chief engineer, has been elected a vice-president of Link-Belt Co., with headquarters at the company's general office, Chicago, as heretofore. Mr. Bergmann came to Link-Belt in 1924, through the purchase of Howe Chain Co., Muskegon, Mich.

John E. Martin has been appointed manager of Link-Belt Ordnance Co., with headquarters at the plant. Mr. Martin started his Link-Belt career in 1927, and since Pearl Harbor has been assistant to Brigadier General G. M. Wells, War Dept., Washington, D. C.

Eshelman & Potter, Birmingham, Ala., and Charlotte, N. C., have been appointed representatives of The Edward Valve & Mfg. Co., Inc., for the Southeastern United States. The ap-

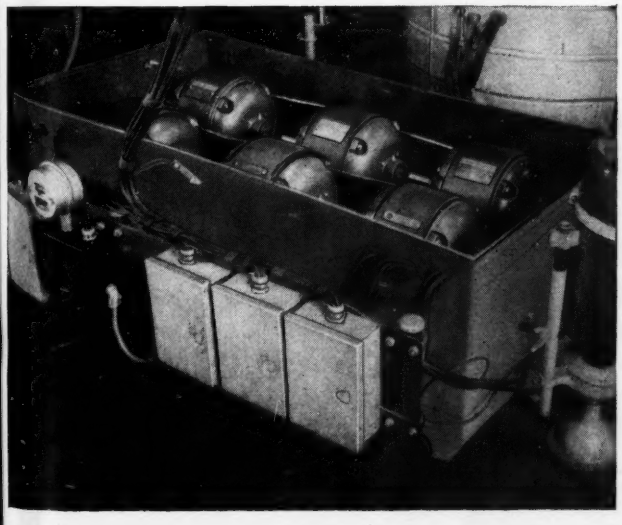
DOUSED DAILY!



G-E Tri-Clad motor coupled to a centrifugal pump on a portable cleaner in the milk plant of H. P. Hood & Sons, Inc., Charlestown, Mass.

POWERING A DAIRY PUMP, this Tri-Clad splashproof motor gets a dousing every day as the plant is hosed down. After years of service, frame and end shields are virtually uncorroded, insulation is going strong. G-E "protection tests", both in the development of the Tri-Clad design and in our daily production, help us assure you of long-lasting service from Tri-Clads on motor-wracking jobs like this.

"Hot Box" at 100% humidity tests TRI/CLAD motor protection

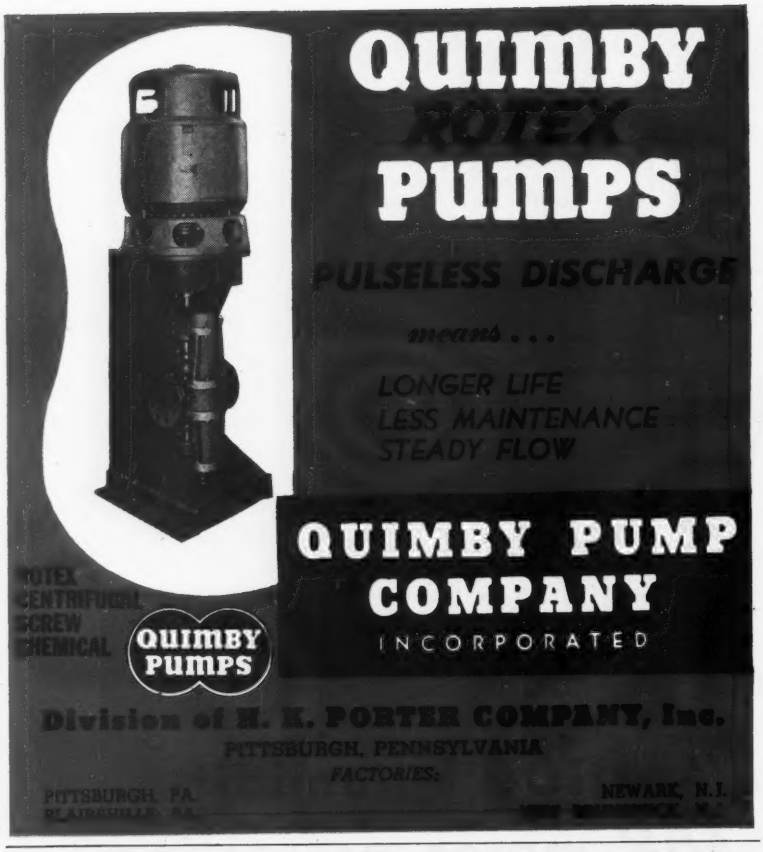


Here is one of the many development tests which helped to prove the *extra* stamina engineered into the Tri-Clad design. In the bottom of this moisture box, just below the motor base, two inches of water was maintained at 212 F. The cover kept the humidity within the box at 100 per cent. By operating motors in this atmosphere to the breakdown point, G. E. got the low-down on the coil insulation's moisture resistance. Tri-Clad motors, in both open and splashproof construction, showed up unusually well in this extra-severe test. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Every week more than 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.



pointment puts the wide experience of a veteran power engineering organization at the disposal of steel valve users of the Southeast. The Edward territory covered by Eshelman & Potter includes North Carolina, South Carolina, Georgia, Florida, Alabama and eastern Tennessee. Principal executives of the Eshelman & Potter firm are Joseph W. Eshelman, who directs the Birmingham, Ala., office and James Potter, who heads the Charlotte, N. C., office.

Manufacturing operations are being established by the B. F. Goodrich Company in DuBois, Pa., according to a recent announcement by T. G. Graham, vice president.

The newest production unit will manufacture products in which rubber and textiles are employed. A. J. Baker, manager of Akron factory employment, will be plant manager in DuBois. B. F. Goodrich recently announced the decision to build a new tire manufacturing plant in Miami, Okla., and construction work will start soon.

Simplex Valve & Meter Co., Philadelphia, Pa., has announced the appointment of the following sales representatives in the territories designated: Carl F. Noel, 428 13th St., Oakland 12, Calif., covering Northern California and Southern Oregon; Case Eng. Co., 457 N. Kingshighway, St. Louis, Mo., covering Southern Illinois and Eastern Missouri; R. S. Stover, 212 Kresge Bldg., Marshalltown, Iowa, covering Nebraska and Iowa; "Jim" Clark Agency, 245 E. Keefe Ave., Milwaukee 12, Wis., covering Wisconsin and Minnesota; and R. O. Luchtenberg, Box 65, Columbus, Ohio, covering Southwest Ohio.

Builders Iron Foundry, Providence, R. I., and Omega Machine Co. of Kansas City, Mo., announce a consolidation whereby the latter becomes a wholly owned subsidiary of Builders Iron Foundry. L. E. Harper continues as president and director of Omega and the company will continue at its present address, 3409 East 18th Street, Kansas City.

Builders Iron Foundry was established in Providence in the year 1820. Builders' comprehensive line of flow meters, controllers, gages, etc., is now distributed by Builders-Providence, Inc., a division of the parent company.

The Omega Machine Co., established in Kansas City in 1928 by E. E. Harper, has developed a line of related products including both volumetric and gravimetric dry feeders and continuous lime slakers. Under the leadership of L. E. Harper, Omega has made noteworthy strides, and today its feeders for the feeding of granular and powdered dry materials such as activated carbon, soda ash, lime, and the like are standard equipment in water and sewage plants and for many industrial applications.

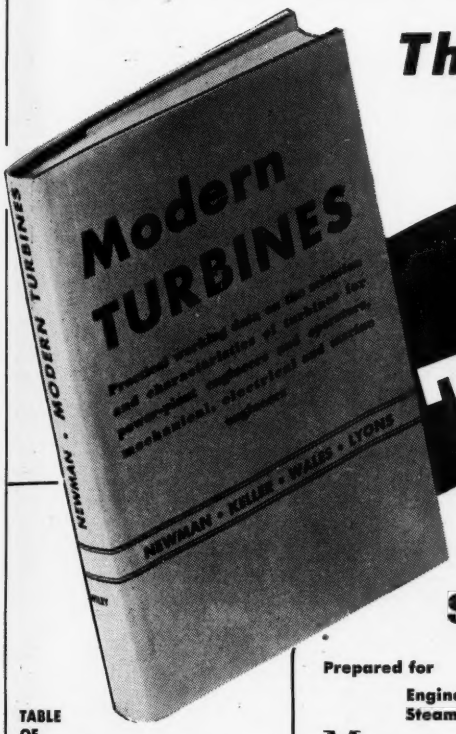
This merger brings together Builders-Providence, Omega and Builders' associate company Proportioneers, Inc., three organizations, each a specialist in its own field. Proportioneers, as engineers and manufacturers, produce a complete line of liquid chemical feeders employed in the treatment of water and sewage, as well as proportioning devices for industrial process blending and treating.

Young Radiator Co. announces the appointment of the W. P. Nevins Co. as sales and engineering representative

Now in Book Form!

The FACTS You Want On

MODERN TURBINES



175 Pages
Illustrated

$2.50

Edited By LOUIS E. NEWMAN, Turbine Division
Cenaral Electric Co., Schenectady, N. Y.

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—ALL with the General Electric Company

Prepared for

Engineers interested in the Specification, Selection, Application and Operation of Steam Turbines

TABLE OF CONTENTS

1. Fundamentals of Steam Turbines.
2. Types of Steam Turbines and Range of Conditions.
3. The Steam Chart and Theoretical Steam Rate.
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6. Performance Charts for Condensing, Non-Condensing, and Automatic Extraction Turbines.
7. Changed Conditions.
8. Steam Turbine Governors.
9. The Generator.

APPENDIX: Turbine Generator Recommended Practices.

REFERENCE LIST

INDEX

MEN who work with Turbines want the *facts*. And they're not given to praising, much less over-praising, *any* book unless it has been of real value to them. Yet here are some voluntary expressions of highest approval of MODERN TURBINES:

"I consider your turbine material and related articles on generators to be the finest work ever printed on power plant equipment."

"Your work contains the only information to be found here which mentions these limitations (of extraction and non-condensing turbines.)"

"The finest discussion of steam turbines that I have seen for some time."

"Besides clearing up the 'fog' generally surrounding turbines, MODERN TURBINES is presented in most interesting form."

"Some of the methods suggested (for steam turbine calculations) are still unknown to many engineers."

This material was originally presented as a series of articles in Power Plant Engineering. It has been expanded, carefully edited and arranged for book presentation, with charts and drawings greatly improved. This makes available a valuable reference and instruction book. Any type of information can be located at once by means of the carefully prepared index.

Also included are these helpful practical features and labor-saving suggestions:

- How to arrive at a method that works for rejuvenating worn-out turbines.
- How to effect real savings with low-pressure turbines.
- How to solve ticklish problems of heating and ventilation.
- How to lay out a new power plant, or recondition an old one.
- How to select a turbine for specific needs.
- How to simplify involved calculations.

If you are a turbine man, you will find this book one of the best investments you have ever made. It is always a satisfaction to have your own ideas confirmed and amplified by an authoritative book. MODERN TURBINES is the book.

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Please send me a copy of MODERN TURBINES on ten days' approval. At the end of that time, if I decide to keep the book, I will remit $2.50 plus postage; otherwise I will return the book postpaid.

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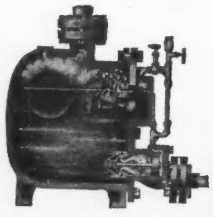

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PISTON-OPERATED STEAM TRAP

Skillfully designed to drain and discharge enormous quantities of water, dirt, boiler compound, scale and other foreign matter removed from steam by purifiers. Also recommended for separators, heaters, headers, long pipe lines, and wherever an extra-large capacity trap is required. For pressures to 650 lbs. Non-collapsible chrome-nickel steel float. Vital working parts of stainless steel.

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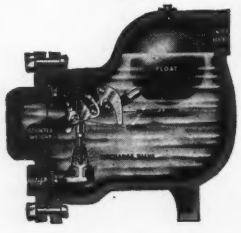

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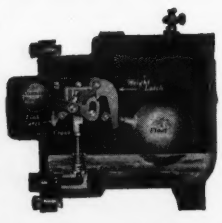
NICHOLSON "Model JR" Compressed Air Traps are specially designed to provide long, trouble-free service in automatically draining air tanks, separators, receivers, aftercoolers, etc. Water-sealed discharge valve, welded stainless steel float. Large capacity, pressures to 200 pounds. Intermittent discharge. Bulletin No. 341.



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WEIGHT-OPERATED STEAM TRAP

Suitable for draining all types of equipment utilizing, storing or conditioning steam, air or gasoline, such as Separators, Line Purifiers, Water Heaters, Tanks, Gasoline Accumulators, Superheated Drains, Turbine Throttle Valve Drips, After Absorbers, etc. For pressures to 1500 lbs. at 1000 degree maximum temperature. All valves, seats and working parts are of stainless steel for long trouble-free operation.

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H. R. T. Boilers	Water Tube Boilers
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Tar and Pitch Stills	Batch Type Oil Stills
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in the Chicago territory. The W. P. Nevins Co. will provide a complete sales and engineering service on the line of Young heat transfer products.

Retirement of Miss Sarah M. Sheridan, vice-president of Detroit Edison, and for many years its sales manager, has been announced by Alfred C. Marshall, president. While Miss Sheridan will not formally retire until March, 1944, she turned over her duties and responsibilities to the organization she has built at the beginning of the year. Angus D. McLay is now responsible for the sales department, having been appointed sales manager in 1938 and elected a vice-president in September, 1943. Roy T. Duncan is commercial superintendent of the sales department, the announcement said.

The Titeflex Metal Hose Co. of Newark, N. J., will hereafter be known as "Titeflex, Inc." The change of name has been made with the realization that the former name is no longer descriptive of all the products manufactured by the company. After the war, this will be even more true, as the company anticipates the manufacture and sale of a broader line of products to a wide range of industries.

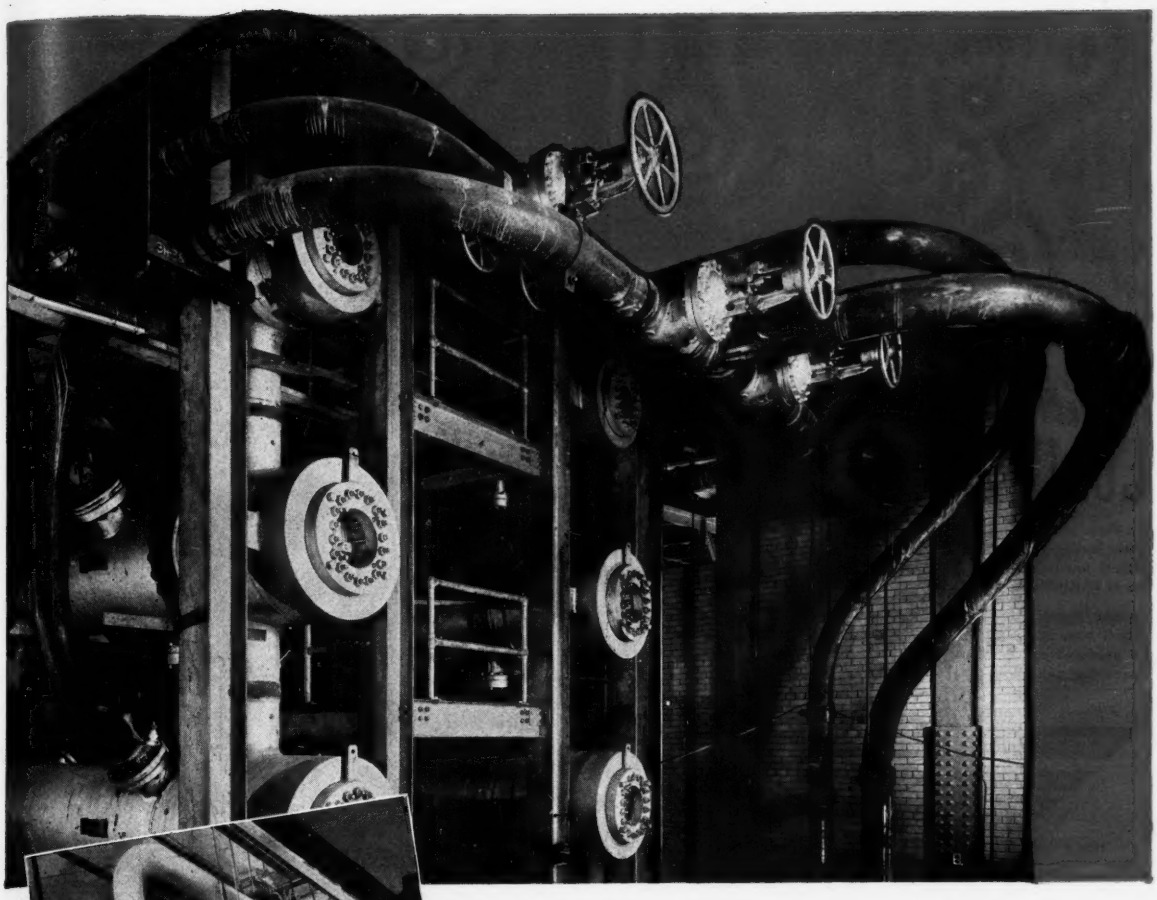
Announcement has recently been made that the exclusive manufacturing and service rights of the steam damper control, the over-fire control and the cam valve control for steam boiler regulation have been bought by the newly formed A-Jacks Automatic Regulator Co., 14 North Clinton St., Chicago 6, Ill., from the National Regulator Co., a division of Minneapolis-Honeywell Regulator Co. These controls were known as A-Jacks Controls for more than 20 yr. The controls were more recently known as a part of the Brown Automatic Boiler Regulation System and were sold, engineered and serviced by the Brown Instrument Division of Minneapolis-Honeywell Regulator Co. Plans are under way for increasing nationwide distribution.

NEWS FROM THE FIELD

Midwest Power Conference

"Power Brings Victory" is the theme upon which the seventh annual Midwest Power Conference will be arranged by Illinois Institute of Technology. The conference will be held April 13 and 14 at the Palmer House in Chicago and will emphasize both war and postwar power problems.

Preliminary plans for the meeting have been announced by Stanton E. Winston, acting head of the mechanical engineering department at Illinois Tech and director of the conference. The tentative program, which already includes 20 topics, will revolve around the following nine sessions: the opening general meeting, three electrical meetings, power plant practice, in-



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The Kellogg Scientific Method of Determining Moments and Forces Electrically has solved many of todays most complex and highly specialized temperature and pressure problems. Prefabricated assemblies designed by this scientific method are installed in public utility, process and marine power plants.

When intricate piping problems arise consult Kellogg regarding this scientific method.

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Its deep, parallel sidewall corrugations combine maximum flexibility with lasting toughness—makes Eclipse Seamless Metal Hose the logical low-cost material for Diesel exhausts and for handling all kinds of liquids or gases where vibration and expansion are present.

Eclipse Metal Hose withstands high pressure and temperatures. Monel hose is stocked in sizes ¼ in. to 2 in. I.D.; steel hose can be produced up to 40 in. I.D. Write us about your problems of conveying non-solids, non-abrasives. Ask for descriptive bulletin.

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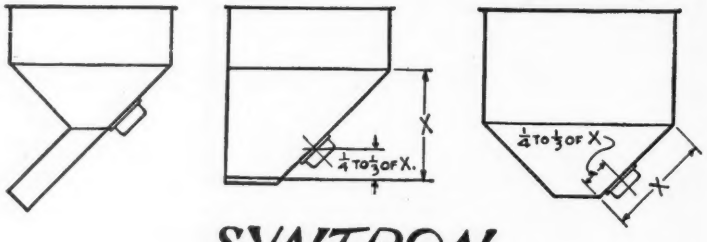

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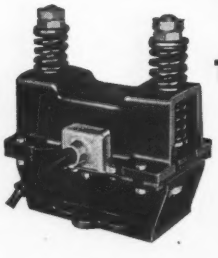

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Eliminate Arching and Plugging

3600 powerful "Electronic-Controlled" vibrations per minute break down arching and plugging—assure a steady, free flow of coal, to pulverizers, stokers, etc.

8 models - - from a little 4 lb. size up to big 500 lb. sizes, with capacities of from 1 cu. ft. hoppers up to big 100 ton bins.

Operate from 110 volts, 220 volts or 440 volt AC current.

Write us about your problem

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dustrial power plants, plant maintenance, fuels and Diesel power.

Keynote speaker will be Alex D. Bailey, assistant to the vice-president of Commonwealth Edison Co. in Chicago. He will speak on "Post-war Planning of the Nation's Power Supply."

J. A. Krug, director of the office of war utilities of the War Production Board in Washington, D. C., will be the featured speaker at the All-Engineers' Dinner, annual social highlight of the conference.

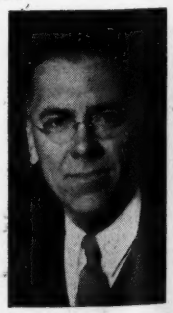
Approximately twenty-five other power authorities will appear on the program.

As in former years, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers will each sponsor a conference luncheon. Speakers will be B. W. Clark, vice-president in charge of sales, Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa., and Dr. C. O. Dohrenwend, chairman of engineering mechanics research at the Armour Research Foundation at Illinois Tech.

Schools working with Illinois Tech in sponsoring the conference include: Iowa State College, Michigan State College, Northwestern, Purdue, Iowa, Illinois, Michigan and Minnesota universities.

The eight engineering societies included in the planning and sponsoring are: Chicago sections of the American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers and American Society of Mechanical Engineers; Illinois sections of the American Society of Civil Engineers and the American Society of Heating and Ventilating Engineers; Western Society of Engineers; and the Engineers' Society of Milwaukee.

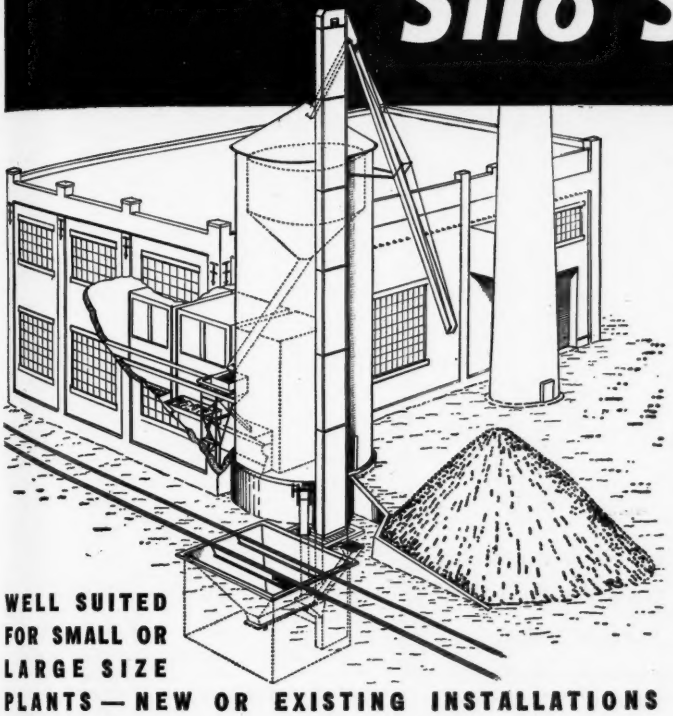
Hugh Thuerk Is New President of N. J. P. & L. Co.



Greystone-Stoller Photo

At a Meeting of the board of directors of the New Jersey Power & Light Co., Hugh Thuerk was elected president and a director of that company. Mr. Thuerk's headquarters will be at Dover, N. J., the principal office of the company. He was formerly president of the Bradford Electric Co., which was re-

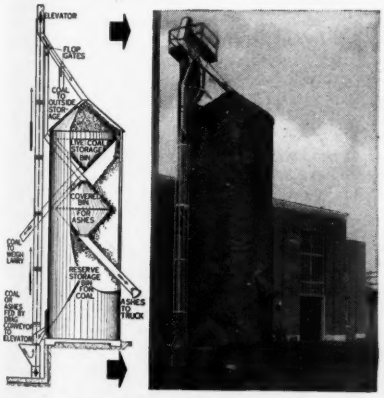
COAL AND ASHES HANDLING SIMPLIFIED WITH THE Silo System



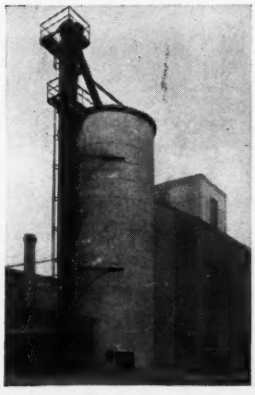
WELL SUITED FOR SMALL OR LARGE SIZE PLANTS — NEW OR EXISTING INSTALLATIONS

Combines Supply and Handling Functions in One Compact Economical Unit

Usually silos are located adjacent to the boiler house but constructed independently, and equipment within the boiler house consists entirely of means for distributing the coal. Frequently a single spout from the silo is all that is needed. Silos may be designed for normal storage requirements or equipped with an auxiliary spout to provide additional outside reserve storage when desired. This system may be arranged to store both coal and ashes. The installation shown above handles coal only, supplying the boiler house from active and reserve storage within the silo and storing out additional reserve ground storage. A traveling weigh larry receives coal from the live storage hopper of the silo and distributes it to the stokers. Talk over your problems with our experienced engineers.



Both coal and ashes are handled here. Coal may be diverted to ground storage through an auxiliary spout. Ashes are discharged to the ashes section of the silo by means of a control gate and independent spout.



Another typical silo installation handling coal only, but without auxiliary ground storage. Coal from the live storage hopper in the silo is spouted directly to pulverizers located inside the building.

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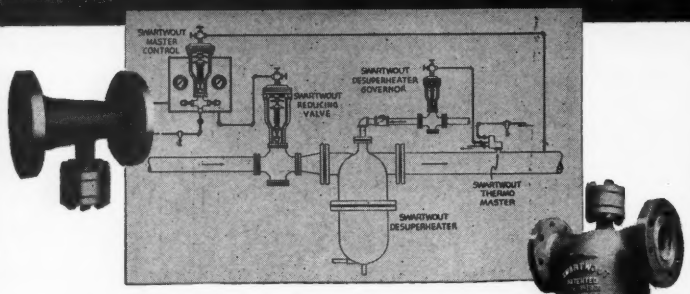

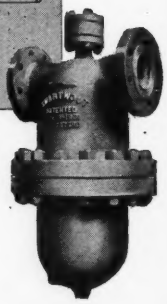

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This NEW book contains information of interest and value to every power plant engineer and laboratory technician. It contains an understandable discussion of the importance of pH, chlorine and phosphate control, their application to boiler water, water purification, etc. It gives authoritative recommendations for accurate control as applied to 34 widely varied industries... shows the complete Taylor line of control equipment . . . tells what to do and how to do it.

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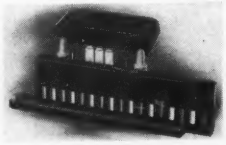

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cently merged with the Pennsylvania Electric Co.

After graduation from Purdue University, Mr. Thuerk was engaged as merchandise manager of the Olean Electric Light and Power Co., Olean, N. Y. Later he became commercial manager of the Keystone Power Corp. at Ridgeway, Pa. He left Ridgeway to accept a position with the Erie Lighting Co., Erie, Pa., as special engineer and successively held the positions of manager and director of sales and manager of operations with that company.

Later, Mr. Thuerk was a member of the staff of the Atlantic Utility Service Corp. of New York City. Before coming to New Jersey Power and Light Co., he was president of Bradford Electric Co. of Bradford, Pa.

Mr. Thuerk has been active in the Edison Electric Institute and is at present chairman of the Post War Planning Committee of that organization.

New List of Standards

THE AMERICAN STANDARDS ASSOCIATION, 129 W. 39th St., New York City, announces the publication of its new list of standards. More than 600 standards are listed, of these 64 have been approved or revised since April, 1943, when the last price list was printed. The standards cover specifications for materials, methods of tests, dimensions, definitions, of technical terms, procedures, and other pertinent engineering data.

One important phase of the work built up during the 25 years that the ASA has been in existence, is in the field of safety engineering. The new list includes 95 safety standards.

Since the war, the ASA has been working very closely with government agencies and with the armed services to provide specifications for certain of the materials necessary to our war effort. Because these standards are developed through an accelerated procedure, they are designated as American War Standards. These are listed separately, and to date, there are 40 already completed and many more under development. These war standards have been produced in the field of safety work, machine tools, quality control, photography and radio, just to mention a few. Every government order is based on specifications: standards are used to accelerate production, conserve materials, maintain a balance between quality and price control, simplify inspection, contracting and subcontracting. All of them are designed to relieve shortages of time, material and man-power.

In each case, the standards approved by the ASA represent general agreement on the part of the maker, seller, and user groups as to the best current industrial practice. More than 600 organizations are taking part in this work.

ASTM Symposiums on Rubbers and Plastics

FORTHCOMING MEETINGS of the American Society for Testing Materials will feature two extensive technical symposiums, one covering the applications of synthetic rubbers, the other on plastics. The discussion on rubber will be held during the ASTM spring meeting in Cincinnati on March 2 (Hotel Netherland Plaza), with morning and afternoon sessions. The Symposium on Plastics is to be held in Philadelphia in

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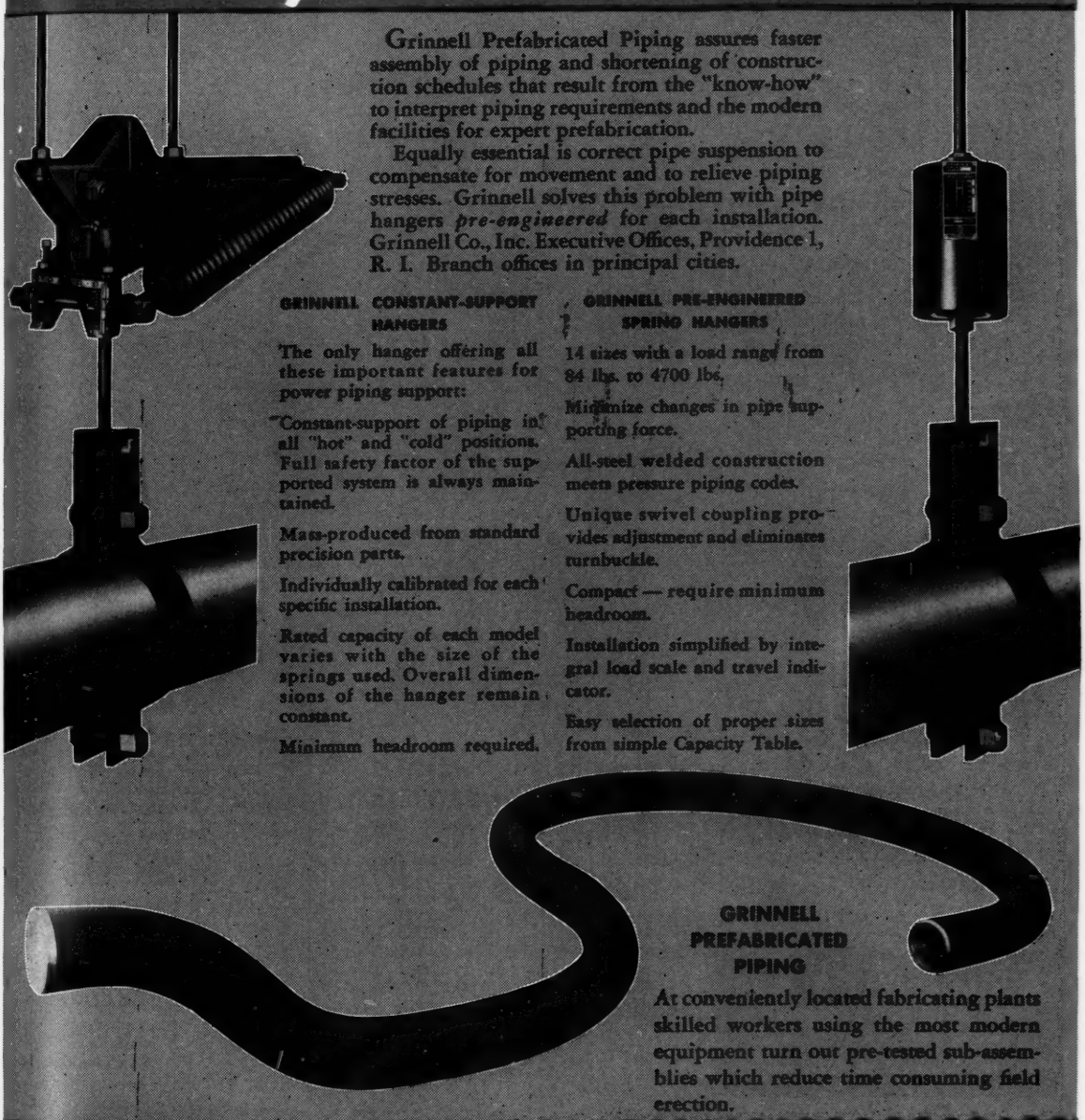

Grinnell Prefabricated Piping assures faster assembly of piping and shortening of construction schedules that result from the "know-how" to interpret piping requirements and the modern facilities for expert prefabrication.

Equally essential is correct pipe suspension to compensate for movement and to relieve piping stresses. Grinnell solves this problem with pipe hangers *pre-engineered* for each installation. Grinnell Co., Inc. Executive Offices, Providence 1, R. I. Branch offices in principal cities.

GRINNELL CONSTANT-SUPPORT HANGERS

The only hanger offering all these important features for power piping support:

Constant-support of piping in all "hot" and "cold" positions. Full safety factor of the supported system is always maintained.

Mass-produced from standard precision parts.

Individually calibrated for each specific installation.

Rated capacity of each model varies with the size of the springs used. Overall dimensions of the hanger remain constant.

Minimum headroom required.

GRINNELL PRE-ENGINEERED SPRING HANGERS

14 sizes with a load range from 84 lbs. to 4700 lbs.

Minimize changes in pipe supporting force.

All-steel welded construction meets pressure piping codes.

Unique swivel coupling provides adjustment and eliminates turnbuckle.

Compact — require minimum headroom.

Installation simplified by integral load scale and travel indicator.

Easy selection of proper sizes from simple Capacity Table.

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At conveniently located fabricating plants skilled workers using the most modern equipment turn out pre-tested sub-assemblies which reduce time consuming field erection.

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two sessions the evenings of February 22 and 23, the first session at the Franklin Institute, and the second on February 23 at the Benjamin Franklin Hotel. Many outstanding leaders in each field will participate.

Persistent demands from users of rubber products for authoritative technical data and information on the application and uses of synthetic rubbers led active people in the Society to suggest this symposium as a feature of the spring meeting. Under the chairmanship of Arthur W. Carpenter, manager of testing laboratories, The B. F. Goodrich Co., and secretary of the society's committee D-11 on Rubber Products, a symposium committee has developed two technical sessions in which prominent authorities in their respective fields will participate.

Except in so far as necessary for background information the authors do not plan to deal with the chemistry or manufacture of the crude synthetics, but instead will give latest information on properties of materials, and other features that would be of concern especially to those who are using the synthetic rubber products.

The symposium on plastics, with many leading technical people in the industry participating, was arranged by the ASTM Philadelphia District Committee under the chairmanship of F. G. Tatnall, Baldwin-Southwark Division, The Baldwin Locomotive Works, in connection with the meetings (February 21 to 24) of Committee D-9 on Electrical Insulating Materials, and D-20 on Plastics. There had not been a symposium in ASTM on this subject since the one in Rochester in 1938. Meanwhile, there have been very notable developments in the field, and Committee D-20 on Plastics has issued a large number of tests and specifications. A feature of the symposium will be the presentation by Dr. G. M. Kline, National Bureau of Standards of information and data furnished by seven technologists covering salient features of leading plastic families.

The Society is planning to issue the symposiums in the form of bound publications.

Buffalo Rapids Irrigation Project to Cost $1,628,000

Bureau of Reclamation, Denver, Colo., plans to begin work soon for completion of second unit of Buffalo Rapids irrigation project in vicinity of Fallon, Mont., following recent approval of program by President Roosevelt. It is expected that WPB will issue priority rating at early date. Work will be concentrated largely on Fallon division, to include construction of a large pumping station at that point, with motor-driven pumping machinery, controls and auxiliary equipment. Another smaller pumping plant will be located at Dobson, near Malta, Mont. A total fund of $1,628,000 has been authorized for project, which will irrigate about 11,600 acres of land.

Municipal Power Project at Madison, Wis.

City Council, Madison, Wis., is arranging a referendum at election to be held April 4, for approval of establishment and operation of a municipal power plant. At the same time, citizens will be asked to approve a bond issue

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CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

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Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

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Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

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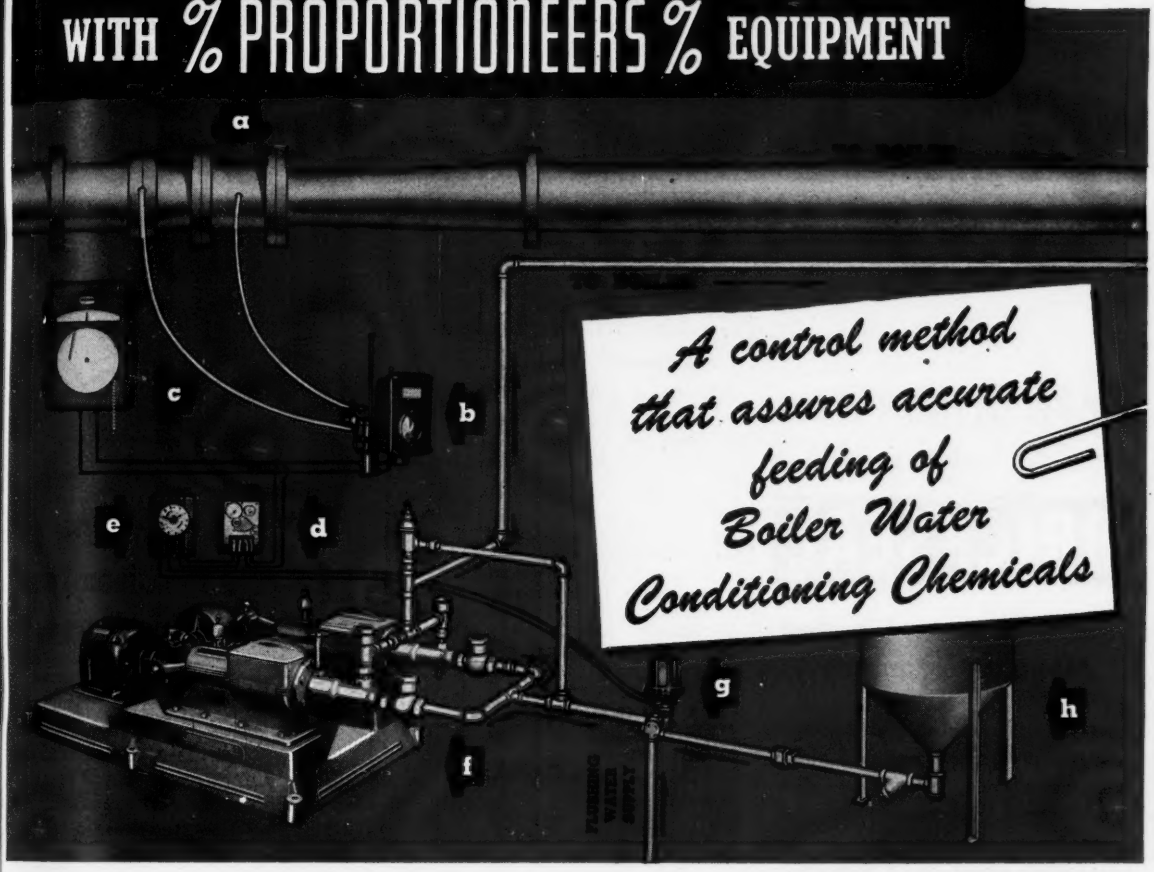

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Differential set up by flow through Venturi Tube **a** or Orifice Plate causes transmitter **b** to send electrical signals whose duration lengthens with increasing flow. Instantaneous and total flows, together with permanent records, are supplied by Chronoflo Receiver **c**. Timer **d** receives signals from transmitter and, after reaching predetermined total, energizes adjustable timer **e**. Thereupon Adjust-O-Feeder **f** injects chemical and, when timer **e** reaches preset point, 3-way valve **g** shuts off chemical **h** and admits flushing water. After a further interval timer resets and Adjust-O-Feeder stops until next feeding cycle is initiated.

For further information send for Bulletin 1100

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Simply brush or spray Brickseal over your refractory lining, and start boiler operation at once. Furnace heat vitrifies Brickseal permanently into all pores, cracks and joints, binding the bricks with a highly-glazed, monolithic coating, impervious to slagging, clinkering, corrosive vapors, flame abrasion and air infiltration.

Sudden temperature changes cannot crack or loosen Brickseal because it remains semi-plastic until boiler cools. Brickseal costs only a fraction of a reline job, and assures long, efficient, trouble-free boiler operation. Write now for sample or Brickseal engineer.

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REFRACTORY CO.
1029 CLINTON ST., HOBOKEN, N. J.

of $11,500,000, of which $11,000,000 will be used for purchase of local power plant and properties of Madison Gas & Electric Co. Of remainder of fund, $363,000 will be used for extensions and improvements in generating station, transmission and distributing lines, and $137,000 to cover other expenses in connection with acquisition and transfer. Plans now under way provide for a postwar development project at plant, with installation of a new 25,000-kw turbine-generator unit, boiler and auxiliary equipment, estimated to cost approximately $700,000. Also for new transmission and distributing lines, with service connections and other operating facilities. Fund of about $200,000 will be appropriated for latter work, including extensions and replacements in gas distribution lines.

Central States Electric To Expend $1,000,000 At Iowa Falls

CENTRAL STATES ELECTRIC CO., Cedar Rapids, Iowa, has secured a renewal of franchise at Iowa Falls, Iowa, for light and service for a period of 20 yr, and in accordance with agreement made with municipality, will carry out an expansion and improvement program to cost about $1,000,000. Work will include extensions in local steam-electric generating station, with installation of additional equipment; additions in transmission and distributing lines, power substations, service connections and other operating facilities. Project will be arranged as a postwar development.

U. S. Rubber's Expansion Program

THE UNITED STATES RUBBER CO. is expanding production facilities of four major tire plants, according to an announcement from Herbert E. Smith, president. These plants are located at Chicopee Falls, Mass.; Eau Claire, Wis.; Detroit and Los Angeles.

More than $25,000,000 will be spent by the company to increase the output of these plants. When the expansion program is completed in the latter part of 1944, the production of tires, in point of tonnage, will be increased more than 30 per cent above that of any previous time.

A large part of the company's investment will be used to reconvert the Eau Claire Ordnance Plant from the making of ammunition to tire production. Previously known as the company's Gillette tire plant, it was taken over by the Government at the time of conversion to ordnance, with the rubber company continuing to operate it for the Government on a contract basis. Additional buildings will be erected and new equipment installed throughout to make it one of the most modern tire-building plants in the country. Large sized tires will be produced in this plant for the duration. The first is expected to be produced by late Spring. Capacity will be reached in the latter half of 1944.

At the Chicopee Falls plant the company is adding several buildings. When this work is completed, this plant will be the largest producer of truck tires east of the Alleghenies, and its total tire-building capacity will virtually double that of pre-war time. Present plans call for completion of construction by late Spring and capacity production in the second half of the year.

Your Blueprint for
MORE POWER
starts with
OAKITE CLEANING

. . . Fast Way to
Descale and Clean Your
Surface Condensers

When lime-scale or oil deposits accumulate on surface condenser tubes the inevitable result is lower operating efficiency. It clearly indicates that THOROUGH CLEANING is needed. But this does not mean a lot of trouble . . . if you use the Oakite method!

Simply introduce recommended Oakite descaling or degreasing solution through the water or steam side of unit as directed, then rinse. Deposits are thoroughly, speedily removed. Not only is normal vacuum restored, but shut-down time is reduced as well!

NEW DIGEST FREE!

This NEW, 16-page Oakite Digest describes successful ways for conserving man-hours and establishing other worthwhile economies on this and 65 other essential power plant maintenance jobs. Send for your FREE copy TODAY!

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OAKITE Specialized cleaning
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MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

New Gulf Coast State Utility Plant of Outdoor Type Is Equipped with Ljungstrom Preheater

Here's a boiler plant in which fuel savings are backed up by sound conservation of steel and other structural materials. Designed for natural gas firing, it has a maximum continuous rating of 425,000 lb steam per hr. Operating pressure is 900 lb per sq in. Gases enter the preheater at 775 deg F, leave at 370, and heat the combustion air to 632 degrees. Preheater and fan assembly are installed out in the open between the steam generator and stack.

• • • • •

Ljungstrom Air Preheaters save fuel two ways. First, they recover heat that would otherwise be lost up the stack, increasing efficiency of the plant by 6 to 10 percent. Second, they provide more effective combustion conditions, a factor of particular importance in burning lean fuels. In some cases, preheating of combustion air makes it possible to use fuels that would otherwise be unsatisfactory.

At the same time, this compact *regenerative* type of preheater saves appreciably on steel and construction materials. First, because optimum heat recovery is obtained with *one-half* to *one-third* the weight of steel in the preheater itself, as compared to other types. Second, because lower weight and compact design permits a simple supporting structure.

Today, the *conservation* features of the Ljungstrom are expanding its application from high-efficiency boiler plants to a wide range of industrial applications where gas-to-air heat transfer can save fuel and improve combustion. These applications include oil heaters, metallurgical furnaces, and the like.

For the complete story on the operating principle and construction features of the Ljungstrom Air Preheater, write for a copy of Bulletin S-1.

PRODUCTION ACHIEVEMENT . . .

The U. S. Maritime Commission has awarded its "M" Pennant and Victory Fleet Flag to the men and women of Air Preheater Corporation.

THE

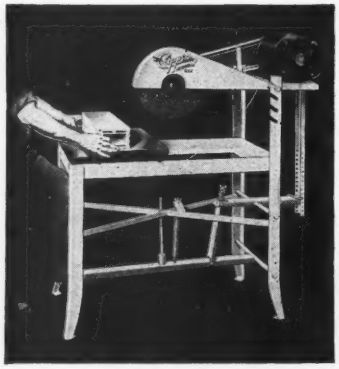
AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York

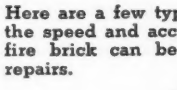
FASTER CUTTING
...with
Clipper Masonry Saws

Your Special Size and Shape Brick or Tile can now be "Tailor-Made" at a moment's notice!



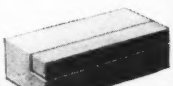
The new Clipper Multiple Cutting Principle makes possible faster cutting of every masonry material regardless of hardness.

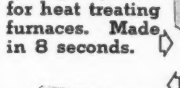
Here are a few typical examples of the speed and accuracy with which fire brick can be cut for furnace repairs.



This acid brick intended for a chemical plant acid chamber was cut completely in two, in 37 sec.

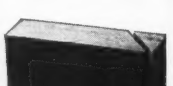
One of many intricate cuts performed on first quality clay brick for heat treating furnaces. Made in 8 seconds.





Silica brick cut lengthwise for open hearth furnace work, only 9 seconds were required to complete this cut!

Basic refractories for steel furnaces or cement kilns must be accurately installed. This magnesite brick was cut in 12 seconds!



Clipper Saws are available for trial. Write for Descriptive Catalogs.

THE Clipper MANUFACTURING COMPANY

4018 MANCHESTER
ST. LOUIS, MISSOURI

In the Detroit plant a considerable amount of new tire-building equipment is being installed and facilities for the greater production of airplane tires are being enlarged. In addition to tires, Detroit is continuing to make a number of other articles for the war effort.

A great deal of new equipment is also being installed at Los Angeles, and when capacity production is attained, this plant will be able to handle twice the rubber tonnage as before. Besides the large sized tires for military and essential civilian use, this plant will turn out its share of passenger car tires to help meet the goal set by the rubber director's office for 1944.

Wyoming Power and Irrigation Project to Cost $8,000,000

BUREAU OF RECLAMATION, Denver, Colo., has preliminary plans under way for development of Yellowstone basin in Montana, with project to include two large dams and 11 small dams on primary rivers in Wyoming and Montana, or a total of 13 dams for entire irrigation and power system. The major dams will be constructed on Big Horn River in Wyoming, to be known as Boysen dam, and on Yellowstone River near Livingston, Mont., designated as Mission dam. The initial development will be the Boysen project, with dam consisting of an earthfill structure about 130 ft high, with crest length approximating 780 ft. A hydroelectric power plant is planned, with initial installed capacity of 10,000-kw, to include transmission lines, power substations and other operating facilities. Station will be used for power supply for pumping stations at different points. Boysen reservoir as now planned will have a total capacity of 730,000 acre-ft, of which 400,000 acre-ft will be utilized for silt detention, 300,000 acre-ft for flood control, and 30,000 acre-ft for irrigation service. This part of project is estimated to cost about $8,000,000, and will form the key structure of the entire development, which is being designed as an early postwar project.

Puget Sound Power Company to Expend $1,500,000

PUGET SOUND POWER & LIGHT CO., Seattle, Wash., has authorized an appropriation of $1,500,000 for extensions and improvements in plants and systems during 1944, or about one-half amount expended for similar work in 1943. Program includes extensions and improvements in transmission lines and distribution system, power substation enlargements, service connections and other operating facilities.

Work to Start on $4,000,000 Alumina Clay Project

COLUMBIA METALS CORP., Securities Bldg., Seattle, Wash., is consummating plans for proposed new plant for extraction of alumina from clay, originally projected a number of months ago, and for which site has recently been selected near Salem, Ore. A tract of 100 acres has been secured about one-half mile from city, and grading and land preparation will be placed under way at once. Plant will comprise a series of

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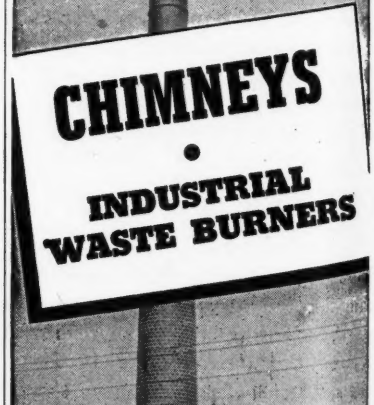

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **Coal Pulverizers**—Bulletin G-30A describes a line of pulverizers for direct-firing, pulverized-coal systems, available in 15 sizes and in capacities from 3100 lb per hour to 25,400 lb per hour. The Babcock & Wilcox Co.

2 **Fire Brick Information**—New bulletin describes Valentine refractories for boiler settings, oil stills, air cooled furnace walls, suspended arches, incinerators, etc. Also contains useful data about dimensions, weights, heat resisting qualities of fire brick. M. D. Valentine & Bro. Co.

3 **Underfeed Stokers** — Folder describes Frederick screw underfeed type stokers recommended for heating and pressure installations requiring from 20 hp to 150 hp. The Frederick Iron & Steel Co.

4 **Slow Speed Coal Crusher**—Bulletin 777 pictures and describes the Jeffrey Flexroll crusher for reducing lump coal to stoker sizes in a single operation. Shows capacity table and installation photos. The Jeffrey Manufacturing Co.

5 **Multiple Spreader Stoker**—"Burns Coal Like Oil" is the title of the new 12-pg board-bound brochure which describes the Fyr-feeder multiple spreader stoker and the work that it is doing in various Army, Navy and Defense Power Plants, as well as on oil conversion jobs. American Coal Burner Co.

6 **Blow-Off Valves**—Bulletin G-1306 is a 12-pg condensed catalog of the complete line of Yarway steam plant equipment. Explains operating features of seatless and hard-seat blow-off valves; columns, water gages, steam traps and contains data on specification of water strainers, etc. Yarnall-Waring Co.

7 **Coal Handling Systems**—Catalog E200 contains useful pictures, drawings, tables and engineering data on modern coal and ash handling systems. Shows typical coal conversion layouts. Gifford-Wood Co.

8 **Baffle Construction Data** — New Bulletin BW-43 covers construction and application of Enco baffle walls to modern boilers and for modernizing existing plants. Many diagrams show streamline baffle arrangements with varying types of boilers and methods of firing. The Engineer Co.

ELECTRICAL

9 **Synchronous Motors and Control for Compressor Drives**—Low-speed synchronous motors and control for compressor drives are featured in a new 4-pg bulletin (GEA-4139) recently issued by the General Electric Co. It describes the application of low-speed synchronous motors, emphasizing necessity of providing the proper amount of flywheel effect to avoid excessive current pulsations; lists most important construction features, especially in respect to the rotors and stators; and discusses the synchronization, field removal, and motor protection afforded by the G-E synchronous motor control.

10 **Power Factor Correction Chart**—This 8-pg report, titled "Preventing and Correcting Low Power Factor," requires but 15 min reading time. Describes a device through which the engineer is provided automatic calculation and correction of low power factor. Also includes a historical resume of electric power development. Every plant utilizing electric power can profit through application of this report. George S. May Business Foundation.

11 **Unitized Switchgear**—New booklets on Unitized switchgear are said to save 30% of usual time required to order, build and install switchgear. Also contain many pages of factual, easy-to-use switchgear information. Westinghouse Electric & Mfg. Co.

12 **Ignitron Mercury-Arc Rectifiers**—Ignitron mercury-arc rectifiers for 501-kw and higher ratings, 250 to 900 volts, are featured in an attractive, new 36-pg bulletin (GEA-3706) recently issued by the General Electric Co. Lists the many advantages of these rectifiers for converting alternating current to direct current in mines, railways, steel mills, electro-chemical, and other industrial plants where d-c is required for general use. Some of these advantages —easy installation, quick starting, quiet operation, and low operating and maintenance costs—are described in considerable detail.

13 **New Mycalex Insulation**—A 12-pg publication describing properties, advantages and applications of G.E. mycalex has been published by the Specialty Division of the General Electric Company's Electronics Department. G.E. mycalex is a material made from mineral ingredients to meet exacting high frequency insulation requirements. It is used extensively as an insulator in various types of electrical apparatus, particularly in radio, industrial control and heating equipment, and is produced in plates, rods, strips and disks from which parts are machined to finished shapes.

14 **Weld Inspection Chart**—A new arc welding inspection chart pictures actual specimens of various results obtained in making fillet and butt welds and describes briefly the appearance and characteristics of proper and improper weld beads. Includes a table on procedure for single-pass horizontal and positioned fillets with "Fleetweld II"; carries data such as electrode sizes, desired current, burn off rates and arc speed. Printed in two colors on a heavy grade of stock measuring 23 in. by 35 in., and is available without charge to inspectors, operators and others concerned with welding. Lincoln Electric Co.

14A **Slide Rule for Selecting Circuit Breakers** — With the Allis-Chalmers Unit-Sub Rule, anyone can easily calculate the interrupting capacity of the 600-v class air circuit breakers needed for control of power in all industrial plants. Use of the slide rule constitutes a more flexible and comprehensive means of properly applying breakers. Rule has been constructed from standard AIEE formulas for determining short circuit currents, and takes into consideration all necessary factors, such as motor load and d-c component. While the slide rule has been specially developed for use in load-center unit substation applications, it can be used to check breakers on any system. Allis-Chalmers Mfg. Co.

FANS, PUMPS AND COMPRESSORS

15 **Turbine Driven Pumps**—Worthington Monobloc centrifugal pumps, with steam turbine drive, for power plants, oil refineries, air conditioning systems, chemical plants, etc., are described in Bulletin W-321-B13B. Capacities 10 to 400 gpm. Ideally suited for conditions where fire risks make other power units unsafe. Worthington Pump & Machinery Corp.

16 **Rotary Compressors**—New Bulletin C-5 tells about actual air-free delivery and other advantages of Fuller rotary two-stage compressors. Capacities to 1800 cfm, pressures to 125 lb. Fuller Co.

17 **Sewage Pump Handbook**—New Bulletin 6201 covers all dry-pit sewage pumps of Yeomans manufacture for industrial and municipal use. Handy selection tables, new installation drawings, up-to-date specifications and other useful data are included in this 32-pg handbook. Yeomans Brothers Co.

18 **Rotary Pumps**—Bulletin No. 304 describes Blackmer rotary pumps, 5 to 750 gpm, pressures to 300 psi. Contains illustrations of operating details and typical capacity curves to show how these units cut pumping costs. Blackmer Pump Co.

INSTRUMENTS AND CONTROLS

19 **Controls** — McAlear catalog describes a line of precision engineered pressure, flow, liquid level and temperature controls for steam, water, air, oil and gas. Company engineers will design and develop controls for specific applications. McAlear Mfg. Co.

20 **Pointer Type Draft Gages** — Easy readability, high sensitivity and other features of Hays pointer type draft gages are described in well illustrated new Bulletin 43-667. Also contains diagrams and data of value to boiler plant operators. The Hays Corp.

21 **Electronic Bin Level Indicator** — Folder describes a dry materials bin level indicator that operates on the electronic principle. The device has no moving parts; also eliminates danger of clogging, arching, or mechanical breakdown; and it is equally effective in measuring all types of material. Mosher Electronic Controls.

22 **Thermometers** — Specifications and application data for Johnson thermometers for liquids and air are given in new Bulletin No. 20. Covers straight and oblique shank, angle patterns, dial thermometers. Johnson Service Co.

List Items You Want On Handy Coupon On Following Page

23 **Metermax Combustion Control** — Catalog N-01M-163 shows how boiler efficiency may be boosted with a Metermax combustion control. It is said to have the flexibility that boiler operators need; adjustment may be changed at any time; unit can be easily returned to manual control. Leeds & Northrup Co.

24 **Valve Operators**—Catalog A8, covers ATC Type 303 valve operators for industrial operation of valves, dampers, or other control devices between two adjustable positions for regulation of temperature, pressure, flow or level. Well illustrated with photographs and drawings, the literature covers essential engineering information, design features and operating data. Valves, commonly mounted to this unit, are illustrated; and, tabular data are given on dimensions and operating force. Automatic Temperature Control Co., Inc.

25 **Photoelectric Pyrometers** — The greater sensitivity and accuracy of Tag Celectray pyrometers is explained in new 38-pg Bulletin No. 1101H. Contains specifications, installation views and other data of value to men with instrumentation problems. C. J. Tagliabue Mfg. Co.

26 **Electronic Flame Control**—How the Fireye control monitors oil, gas, pulverized coal burners electronically is described in new Catalog 51. This device instantly detects flame failure, cuts off fuel supply. Catalog also tells about Fireye electronic boiler feedwater control. Combustion Control Corp.

27 **Portable Balancing Equipment** — Equipment and methods for balancing steam turbines, motors, fans, blowers, generators and other machine parts are described in Bulletin 12-V. A vibrometer and stroboscope used in combination form essential parts of equipment. Vibroscope, Inc.

28 **Temperature and Humidity Controls** — A complete line of self-operating and air operated controls for accurate, automatic temperature and humidity control for industrial processes, heating or air conditioning systems is described in Circular 2520. The Powers Regulator Co.

MECHANICAL TRANSMISSION

29 **Standard and Specialized Belts** — New catalog furnishes complete information on the Gilmer line of standard V-belts, endless or non-endless flat belts, and a complete range of specialized belts for use wherever standard belts are unsuited. L. H. Gilmer Co.

30 **Handbook on V-Belts** — 16-pg pocket-size handbook entitled, "Plain Facts on Wartime Care of Rubber V-Belts," applies to all makes of V-belts and explains ways V-belt construction affects its maintenance, what determines life expectancy of a set of V-belts and what to do about worn sheaves. Allis-Chalmers Mfg. Co., Texrope Div.

31 **Bevel Gear Universal Joint**—Bulletin CS-10 describes new precision cut, manganese bronze, bevel gear universal joint with angular range of 0 deg to 135 deg on vertical center line or 0 deg through 360 deg on horizontal center line. Recommended for remote control of valves, pumps, engines, antennae, ventilators and other equipment in inaccessible locations, or for centralized control of widely separated units. Bulletin also gives data on brackets and shaft hangers. Condenser Service & Engineering Co.

31A **Care of Chain Belt Drives**—"Wartime Care of Chain Belt Drives" is a booklet giving information on maintenance, lubrication and repair of chain belt drives. Booklet was produced with the idea of helping users to get the most out of their existing drives and save some costly delays and unnecessary expense. Chain Belt Company.

PIPING, VALVES AND FITTINGS

32 **Welding Fittings**—As much a text book as a catalog, 216-pg presentation gives a wealth of information on welding fittings and forged steel flanges. Contains engineering data that will prove invaluable to the man who purchases, designs or specifies piping, fittings and flanges in carbon and alloy steels. Taylor Forge & Pipe Works.

33 **Electric Equipment for Pipe Thawing** — Three different electrical methods for thawing frozen pipes safely, quickly and economically are discussed in GEA Bulletin 2059C. Contains practical information for plumbers, welding shops, water departments, plant maintenance men. General Electric Co.

34 **Internal Pipe Insulation**—Book describes Insidline, an internal insulation, developed to enable ordinary carbon steel pipe, with its comparatively light weight and low cost, to stand up under pressure at temperatures above 1000 deg F. By holding the temperature of the pipe itself to 650 deg F or below, "creep" does not occur and the pipe can be operated indefinitely at the usual stress allowances. In addition to saving expense of building special pipe from costly alloy steels, Insidline simplifies pressure piping design by reducing number of expansion joints, bends, and other expansion provisions. Baldwin-Hill Co.

35 **Pre-Engineered Spring Hanger** — Piping engineers wanting simple spring hangers to support modern flexibly supported piping systems will welcome news of the Grinnell pre-engineered hanger. Its all-steel welded construction meets pressure piping code. A unique swivel coupling provides adjustment and eliminates turnbuckle. Its compact design cuts required head room to a minimum. A descriptive bulletin gives full data on the hanger, including simple capacity table. Grinnell Company, Inc.

36 **Steam Trap Guide**—"How to Choose a Steam Trap" is the title of a new informative steam drainage guide, 40 pg of condensation rate charts, graphs, tables—formulas for computing condensing capacity of steam using equipment—trap sizes for unit heaters, header drips, jacketed kettles, etc. The V. D. Anderson Co.

37 **Underground Conduit Systems** — Catalogs contain useful information on pre-sealed insulated pipe units for underground transmission of steam, hot water, oil, hot or refrigerated process liquids. Engineered for maximum efficiency and durability, these factory-built systems are delivered ready for installation. The Ric-wiL Co.

38 **Silent Check Valves**—Catalog 142 contains complete information on the Williams-Hager flanged check valve. No webs to hamper flow; operates in any position. Furnished in a variety of materials in sizes from 1 in. to 20 in.; pressures to 6000 lbs. The Williams Gauge Co.

39 **Valve Selection Guide** — Catalog describes bronze, iron and steel valves, boiler mountings; fittings, gages, flanges; lubricating devices, whistles; steam tables for saturated and superheated steam. Write for Catalog 78 and the Guide for Selecting Valves. The Lunkenheimer Co.

PRIME MOVERS

40 **Geared Steam Drives** — Helpful data on geared steam drives for operating machinery at speeds lower than economical turbine speeds will be found in Booklets 2230-A, 2278. Describes integral or coupled gear ratios from 2-to-1 through 14-to-1. Westinghouse Electric & Mfg. Co.

41 **Diesel Engines**—Data covers a line of Diesel engines in sizes 5 to 2000 hp generator sets, power units, pumping units, etc. Rogers Diesel & Aircraft Corp.

42 **Power Saving Turbines**—Bulletin S-116 illustrates and describes application, construction, savings effected and advantages of the Terry solid wheel turbine. The Terry Steam Turbine Co.

WATER TREATMENT

43 **How We Read Water**—A 48-pg H.O.H. booklet on steam and return system corrosion—how to get accurate chemical proportioning — refrigerating brines—how we read water—interesting cases of control of corrosion, making pipes and boilers last for the duration—how we saved $25,000 in equipment in one plant . . . and many other vital water treatment facts. D. W. Haering & Co., Inc.

44 **Deposits in Cooling Water**—Technical Reprint No. 474 presents a discussion of the two subjects: Microbiological Deposits in Cooling Water Circuits and Chlorination of Condenser Waters. Contains many helpful charts and photographs, also extensive bibliography on water treatment and corrosion control. Wallace & Tiernan Products, Inc.

45 **Feedwater Treatment**—4-pg folder introduces Tanalginate, new protective and reactive colloidal material for conditioning boiler feedwater. Product is used in conjunction with such inorganic chemicals as phosphates or alkali. The Bird-Archer Co.

46 **Modern pH and Chlorine Control**—A completely revised 83-pg handbook and catalog, of value to every power plant engineer and operator, is available from W. A. Taylor & Co. It provides: (1) A simple explanation of pH control and the methods for making colorimetric determinations; (2) precautions to be observed; (3) discussion of

This coupon must be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

FEBRUARY, 1944

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph numbers:

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the application of pH and chlorine control to 31 different fields. Also describes Taylor slide comparators for general pH and chlorine control, and for determination of phosphates, silica, total iron, etc., in boiler water.

MISCELLANEOUS

47 **Water Cooling Towers** — Bulletin 40-A describes various types of cooling towers—wood and steel—atmospheric, deck and coil; forced and induced draft—horizontal and vertical fans—featuring low pressure water distribution and sound engineering to give improved cooling efficiency, reduced operating cost. J. F. Pritchard & Co.

48 **Gasket Design Chart**—New Goetze gasket chart shows cross-sections and explains construction of many popular gasket designs. Also contains helpful suggestions for ordering or requesting quotations on gaskets. Goetze Gasket & Packing Co.

49 **Lubrication**—16-pg book entitled "Helping Industry Help America" contains case histories which show how engineering service in applying petroleum products in general lubrication, processing, mining, textile manufacturing and other operations is increasing American production. Sun Oil Co.

50 **Improvement of Metals by Forging** —New 40-pg technical reference book contains many practical suggestions on use of forgings for product improvement. Prepared especially for design engineers, metallurgists, production and operating men. The Steel Improvement & Forge Co.

51 **Manganese Steel Uses**—Where and how to use manganese steel to prolong the working life of crushers and pulverizers, elevator buckets, pumps, gears, cable sheaves, etc., is explained in Bulletin 1143-C1, recently issued by American Manganese Steel Div., American Brake Shoe Co.

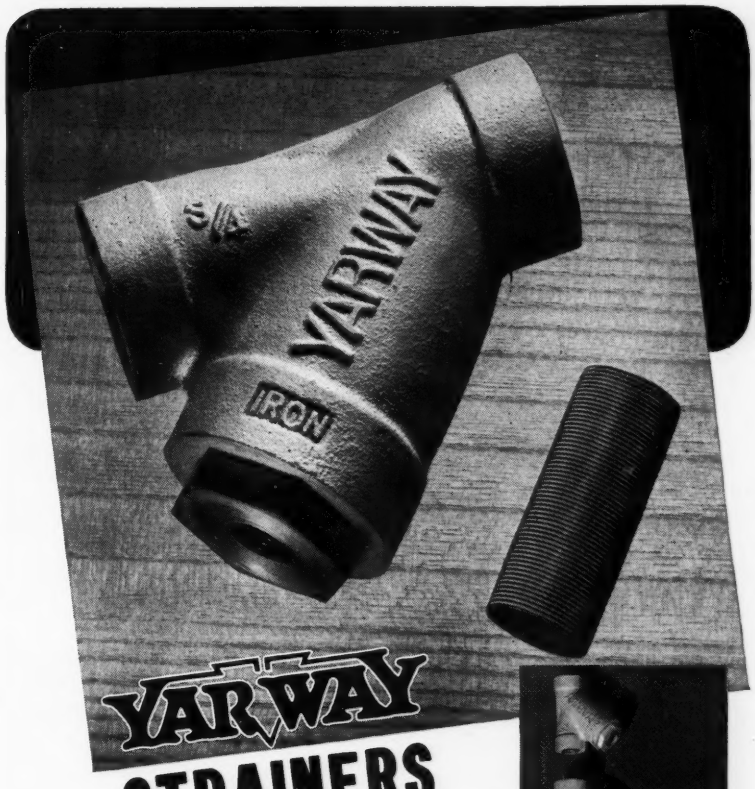
52 **Sludge Solvent and Carbon Remover** — Literature describes a liquid compound for keeping oil systems operating at maximum efficiency by removing the hard carbon formed on burners and preheaters when fuel oil is burned, and by dissolving sludge in oil tanks. Maxfal Chemical Co.

53 **Metallizing Tools**—Catalog 42B describes Metco metallizing guns, wires, surface preparing tools and other metallizing accessories in detail. In addition, it tells how sprayed metal coatings are saving critical materials and manpower in the production and maintenance of war-needed parts and equipment. Metallizing Engineering Co., Inc.

54 **Lubrication Chart** — Newly issued bulletin describes Albany lubricants for industry; includes handy recommendation chart for lubricating compressors, conveyors, pumps, shafting, steam engines, turbines and other equipment. Albany Grease Co., Division of Adam Cook's Sons, Inc.

55 **Industrial Unit Heaters**—A new bulletin, No. 65, has just been published by the Electric Air Heater Co., Division of American Foundry Equipment Co., describing two new models of Electromode industrial unit heaters. These heaters are said to be ideally suited for heating isolated buildings, offices or spaces where intermittent and high efficiency is desired. Easily installed in any idle space at any level, they conserve floor space, provide constant air circulation and are easily regulated. Bulletin describes the construction, operation and application of these new units with capacities 5112 to 204,900 Btu. Specifications, drawings and other data are also outlined.

56 **Refractory Concrete** — 24-pg book features characteristics of Lumnite, methods of making refractory concrete, heat-resistant concrete and refractory-insulating concrete. Book contains many photographs and tables. Atlas Lumnite Cement Co.



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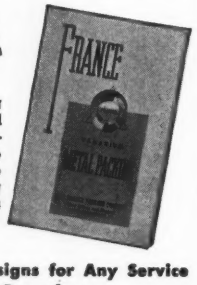

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NEW ENGINEERING BOOKS

ASTM Specifications for Steel Piping Materials. Prepared by ASTM Committee A-1 on Steel. Paper cover; 6 by 9 in.; 255 pages. Published by the American Society for Testing Materials, 260 So. Broad St., Philadelphia 2, Pa., 1943. Price $1.75.

This 1943 edition of the ASTM standards on steel piping material is a compilation of all of the specifications issued by the ASTM covering steel piping materials including 44 standards and 25 emergency alternate provisions that have been issued to aid in expediting procurement. Ten specifications are given on boiler, superheater and miscellaneous tubes; sixteen cover various types of pipe; five cover still tubes; five deal with carbon alloy steel castings for valves, flanges, and fittings. During the war period designers are being forced to make substitutions for materials formerly in use for specific purposes and this edition of the piping specifications is a guide that all industry regards as most authentic.

National Fire Codes for Flammable Liquids, Gases, Chemicals and Explosives. Compiled by Robert S. Moulton. Hard binding cloth cover; 6 by 9 in.; 504 pages. Published by the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass., 1943. Price $3.00.

This book comes as a byproduct of the activities of the National Fire Protection Association as it is a compilation of many codes which the Association has helped to formulate. This volume supersedes the National Fire Codes for Inflammable Liquids and Gases published in 1938 and is divided into nine parts as follows: Flammable Liquid Storage and Handling; Oil and Gasoline Burning Equipment; Liquefied Petroleum Gases; Utilization of Flammable Liquids; Gases; Refrigeration and Fumigation; Explosive and Nitrocellulose Materials; Tables of Properties—Hazardous Chemicals; Flash Point

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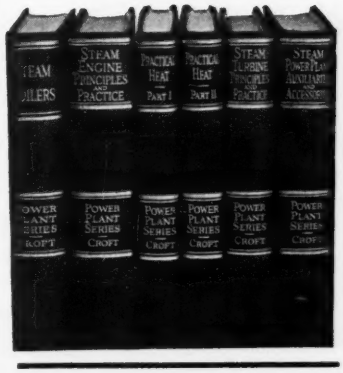

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Piping Stress Calculations Simplified. By S. W. Spielvogel. First edition; 83 pages, 9 by 11 in., hard binding cloth cover. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y., 1943. Price $2.50.

In this book, the pipe designer will find many of his problems worked out in form, requiring only the substitution of the figures pertaining to his particular problem and carrying through the mathematical procedure indicated. The author discusses in sufficient detail the mathematical theory he employs in calculating expansion stresses in high-temperature power piping so that his procedure can be traced from principle to actual calculation of typical problems. The book, however, is so arranged that one familiar with pipe calculations can refer quickly to formulas or computations involved in any specific case without reviewing the theoretical background. The various problems are treated under the headings: Single-plane piping, the case of moving anchors, thrust line, curved branches, stress coefficient, three-dimensional piping, simplified solution of equations, combining moments in three-dimensional problems; method of combining stresses, pipe lines containing circular quarter bends, computing products of inertia, three-dimensional pipe containing quarter bends, three-dimensional pipe lines of various flexibility, three-dimensional line containing corrugated sections. The book closes with three appendixes giving tables, charts and other information useful in making piping calculations. The book may be classified as a manual for pipe designers, and as such should prove a time saver in the solution of typical problems.

Maintenance Arc Welding. Edited by A. F. Davis and Ed. C. Powers. First printing; 234 pages, 6 by 9 in., semi-flexible simulated leather binding. Published by The James F. Lincoln Arc Welding Foundation, Cleveland, O., 1943. Price in U.S.A. $0.50, elsewhere $0.75.

This is the first volume to be published by the Lincoln Foundation on the application of arc welding in maintenance of metal equipment and structures. It contains 25 of the outstanding papers given awards in the 1940-42 Progress Program conducted by the Foundation and which were selected because of their value to maintenance engineers. Each paper was written by the man most familiar with the job described and the information given is sufficiently detailed that a reader familiar with arc welding should have no difficulty in using the material as instructions to follow in similar jobs. The industries represented by the articles are: Bakery, blast furnace, cement, ceramic, chemical, coke oven, copper, cracking still, piping, farm, fiber, foundry, furniture, gravel, tool, oil, power, railway, refinery, saw mill, steel mill, iron ore, and trucking. The group deals with the use of arc welding in reclaiming broken and worn parts and also gives details on the application of welding in the fabrication of replacements. In many cases the costs of completing the jobs are itemized. The book is a valuable contribution to the available literature on the subject of arc welding.

Lubrication of Industrial and Marine Machinery. By William Gordon Forbes. 319 pages, 5½ by 8½ in., hard binding cloth cover. First edition. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y., 1943. Price $3.50.

This comprehensive book on lubrication is made up of 36 chapters and is intended as a manual to be used to explain and solve everyday problems that arise in lubricating engines and machines of various types. In the first part of the book the author lays a foundation of fundamental information dealing with the distillation of oils, chemistry of petroleum, refining, blending, dewaxing, compounding, testing of oils and interpretation of specifications. How heat and pressure affect lubricating oils are discussed, also the effects of metals on lubricating oils. A complete chapter is given on the theory of bearing lubrication and the formation of oil films which prepares the reader for the several chapters that follow dealing with the specific problems encountered with roller bearings, steam engines, steam turbines, hydraulic turbines, air compressors, vacuum pumps, pneumatic tools, refrigerating machinery, gas compress-

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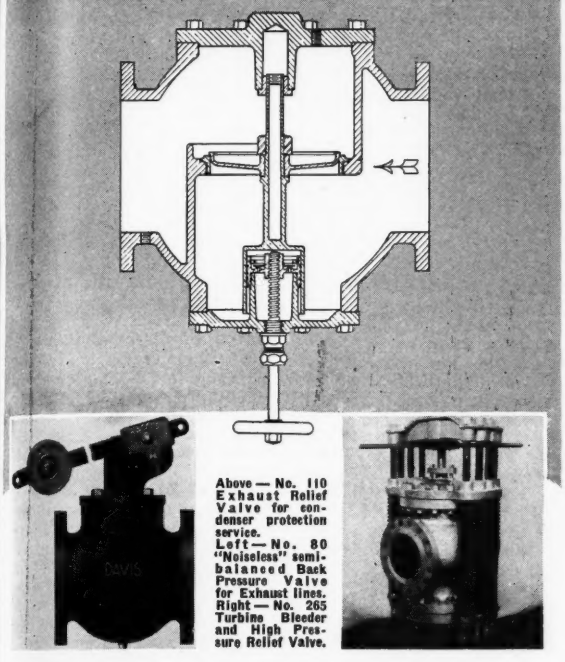

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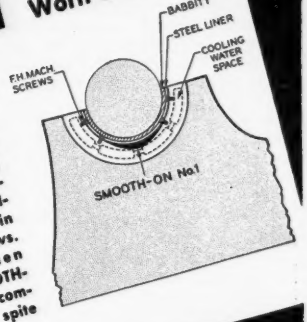

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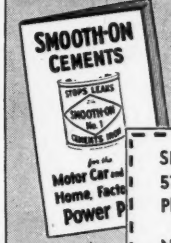

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ors, internal combustion engines, reducing gears, machine tools and special applications in steel mills, paper mills, textile mills, heat treating, and lubricating problems of wire ropes and cables. Oil purification and reclaiming is the title of one chapter which presents paragraphs on settling, centrifuges, strainers, absorbent filters, adsorbent filters, distillation of volatile impurities, and coagulation of impurities with chemicals. Another chapter deals with greases, their physical and chemical characteristics, methods of testing and application to machinery. It is a book filled with information useful to any man in charge of the maintenance of machinery written in terms readily understood by the practical man.

Lubricants and Cutting Oils for Machine Tools. By William Gordon Forbes. 90 pages, 5½ by 8½ in., hard binding cloth cover. First edition. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y., 1943. Price $1.50.

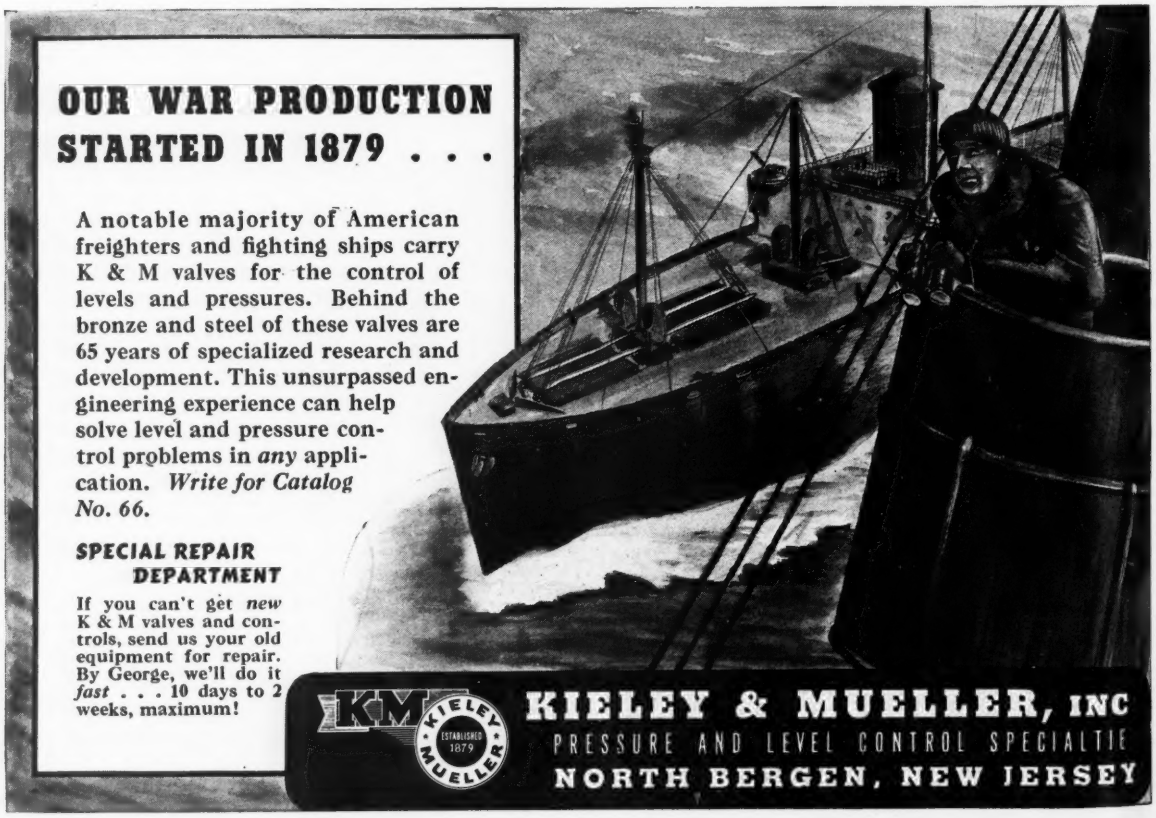
Although this book deals with the practical use of lubricants for machine tools, it does so by first acquainting the reader with the fundamental principles of the problems involved, not extensively but sufficiently to give one a feeling of confidence in the use of lubricants for specific purposes. A chapter on tests and specifications brings the reader up to date on present methods and nomenclature. Greases are considered in another chapter, then types of machine tools. Following are chapters on specific lubricants such as those for machine tools and metal cutting oils. The machinist will find comfort in following suggestions made in a chapter on skin infections. While this book is adapted in part from the author's more detailed book entitled "Lubrication of Industrial and Marine Machinery," it will be found sufficiently complete to guide operators of machine tools in their lubricating problems.

Manual of Instructions on Proper Firing Methods. 58 mimeographed pages, 8½ by 11 in., paper bound. Published by the Smoke Prevention Association of America, 139 N. Clark St., Chicago, Ill., 1943. Distributed on a complimentary basis to coal dealers and consumers interested in fuel combustion and conservation, air pollution and smoke abatement, postage required $0.25.

In this manual are eight complete papers written by well known engineering authorities in the combustion field, selected for their permanent value to fuel users by officers of the Smoke Prevention Association of America. The list includes: Preventing Spontaneous Combustion in Stored Coal, by J. F. Barkley; How to Reduce Smoke From Hand-fired Furnaces, by A. P. Kratz, J. R. Fellows and J. C. Miles; The Service Engineer, by Stewart Orgain and Phil Edwards; Underfeed Stokers, by E. H. Smith; Practical Application of Statistical Methods for Controlling Coal Quality, by Henry F. Hebley; Overfire Air Performance Applied to Stationary Plants, by H. C. Corroll; The Modern Spreader Stoker, by Otto De Lorenzi, and Chain Grate Stokers, by Frank X. Gilg. Engineers will find in this book valuable instructions for the selection and care of fuel, operation and maintenance of fuel burning equipment and information on the process of combustion.

Symposium on Radiography. Arranged and edited by Lars Thomassen, Chairman, Symposium Committee and Subcommittee V on Technical Programs of Committee E-7 of the ASTM. Hard binding, cloth cover, 6 by 9 in., 265 pages. Published by the American Society for Testing Materials, 260 So. Broad St., Philadelphia 2, Pa., 1943. Price $4.00.

In this book are 18 technical papers, prepared by outstanding authorities, assembled from among papers presented before the ASTM at the 1942 Symposium and at previous meetings. The basic purpose of this volume is the development of a better understanding of radiographic tests and their significance on the part of both the consumers and producers of materials. In the first part of the book, the reader is given fundamental information on the principles of the radiographic process, introduction to gamma-ray radiography, and the problem of radiographic inspection. With this as preparatory groundwork, the remainder of the book deals with specific applications of radiography in foundries, production problems, welding processes, casting magnesium, boiler shops, pipe fabrication, and other industrial uses. Also included are papers on equipment and instruments used in producing and controlling X-rays. Inspection by radiography has become so common in the metal working industries that an understanding of its principles is needed by every engineer, and this book, while in some parts takes on the nature of a textbook with explanations of principles, deals mainly with applications in various fields in a way that is almost like popular reading but presents many tables, curves, photo-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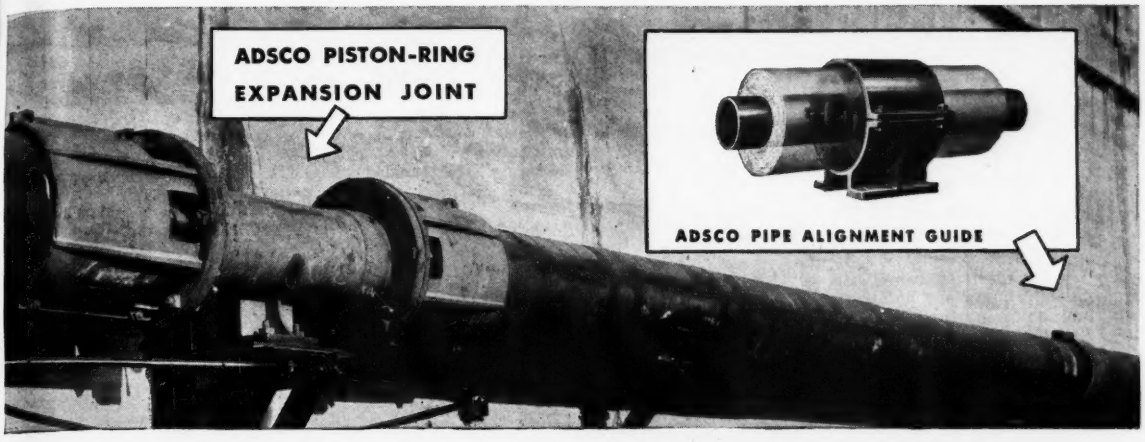

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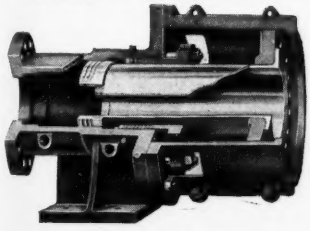

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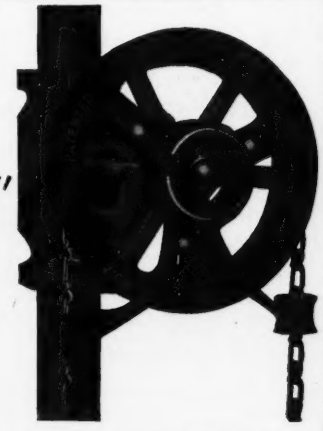

Every overhead valve in your plant should have the easy, safe, instant control from the floor which Babbitt Sprocket Rims provide. . . . Babbitt Rims are low in cost; quickly attached; they save time, steam and accidents. Install them now. Write for descriptive folder.

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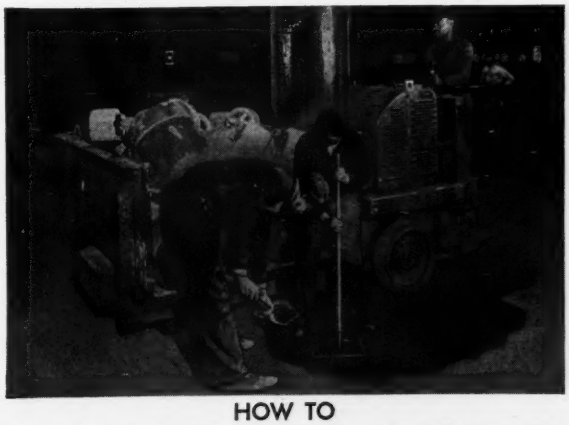
—Adjustable—
SPROCKET RIM
with Chain Guide



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graphs and data gathered during research work that is useful to the man in industry who has need to inspect materials by radiography.

Company Museums. By Laurence Vail Coleman. Published by the American Association of Museums, Washington, D. C., 1943, hard binding, cloth cover; 6 by 9 in., 174 pages. Price $2.50.

The author of this book is the director of the American Association of Museums and sees more clearly than the average citizen the value, not only to an industrial concern but to the entire community in which it is located, of a well planned, well kept company museum. These museums are used for a variety of purposes principally educational and informative. They are devoted to the history past and current, of their parent companies and to technical matters in their lines of business and are considered one of the best activities for building good public relations. This book is therefore addressed to business men and its main purpose is to show the nature and usefulness of company museums, and to give some fundamental and specific information on their management. A considerable section of the book is devoted to descriptions of 80 company museums in the United States and three in Canada. A reading of this book will help in developing an appreciation of the work of those who have built the foundations of our present industries.

Studies in Arc Welding—Design, Manufacture and Construction. First edition. 6 by 9 in., 1295 pages, semi-flexible simulated leather cover. Published by The James F. Lincoln Arc Welding Foundation, Cleveland, O., 1943. Price in U.S.A. $1.50, elsewhere $2.00.

In this book are printed, practically in full, 98 outstanding papers on arc welding submitted by trained technicians and engineers in the James F. Lincoln Arc Welding Foundation's 1940-42 Industrial Progress Award Program. The articles treat in comprehensive and detailed form the latest arc welding practice in modern industry. The book provides engineers, designers and workmen with detailed instructions on specific jobs and will furnish engineering, technical and trade schools with authentic information on arc welding design applications and welding data which may be translated into new applications. Particularly helpful is the great amount of cost data which are given in connection with specific jobs. The book is conveniently divided into the following sections which classify them according to industries: Automotive, 11 chapters; Aircraft, 7; Railroad, 9; Watercraft, 4; Structural, 11; Furniture and Fixtures, 6; Commercial Welding, 4; Containers, 6; Machinery, 40. This comprehensive work covers nearly every conceivable application of arc welding in such extreme detail as to be practically a manual for carrying out the numerous jobs described.

How To Pass a Written Examination. By Harry C. McKown. First edition. Hard binding, cloth cover; 5½ by 8 in., 162 pages. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y., 1943. Price $1.50.

The author of this book, who has had broad experience as a writer, lecturer, editor and college professor, has had an opportunity to study the reactions of individuals as they approach and take written examinations for such purposes as school grading, securing a job, entering civil service positions or the Army or Navy He states in his preface that "It is truly amazing, then, in the light of this forty-one-century use of examinations, the development of the testing movement, and the widespread utilization now being made of this device, that practically no attention whatever has been given to the other side of the problem—that of assisting the examinee to take these examinations intelligently. As a result, few are the individuals who make any definite attempt to develop efficient examination-taking techniques." He deplores, as do nearly all prospective examinees, the lack of information in book form and instruction by educational institutions on this subject of taking an examination. The author hopes this book will be a start toward plugging this great gap in our educational program. While the book stresses written examinations, it contains many suggestions equally applicable to other types of examinations. Dealing first with the why of examinations, the author then gives suggestions as to how to prepare for an examination — emotionally, physically and mentally. Three chapters are then given on the actual taking of the examination and these are followed by a chapter telling what to do after the examination. It is a forthright piece of literature which has long been needed and should be welcomed by those giving as well as taking any kind of examination for the purpose of determining the knowledge or skill of a human individual.

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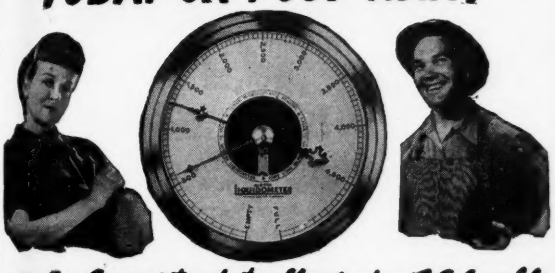

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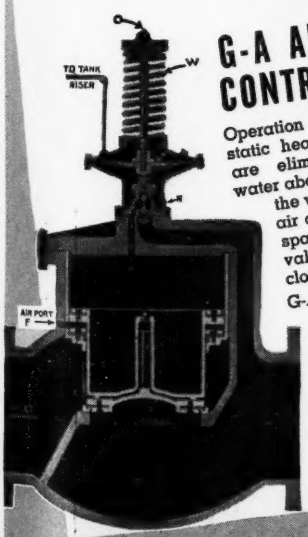

Operation of these valves is by static head. Surges or shock are eliminated because the water above the piston cushions the valve in opening, while air drawn into the annular space through the port in valve body prevents valve closing too quickly.

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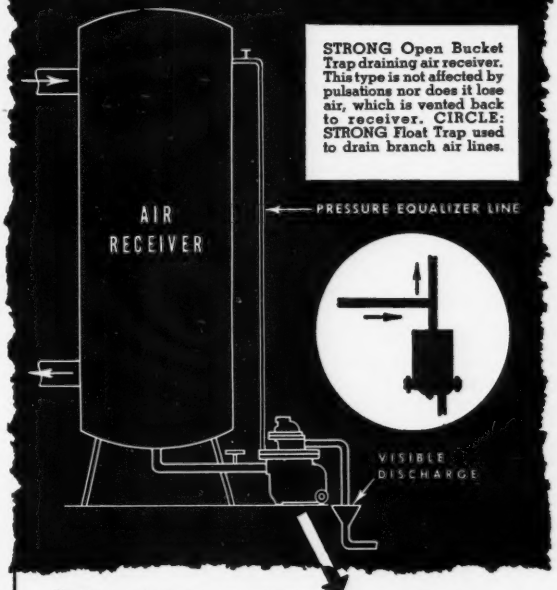
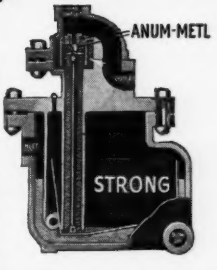


STRONG Open Bucket Trap draining air receiver. This type is not affected by pulsations nor does it lose air, which is vented back to receiver. CIRCLE: STRONG Float Trap used to drain branch air lines.

Reciprocating compressors cause pressure surges in air receivers. These pulsations tend to "bounce" buckets of inverted bucket traps, resulting in excessive wear of parts, continual discharge and loss of air.



STRONG Open Bucket Traps are not affected by such pulsations. Only the weight of condensate in the bucket causes them to discharge. No air is lost during discharge, and air displaced from the trap by incoming condensate is vented back to the receiver.

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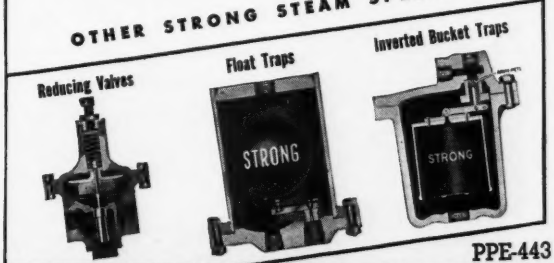

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STRONG

STEAM SPECIALTIES

Power Plant Construction News

Calif., Downey—Consolidated-Vultee Aircraft Corp., Vultee Field, Downey, near Los Angeles, will make extensions in plant for increased production for Government, including installation of machinery and electric power equipment, estimated to cost about $300,000. Financing will be provided by Defense Plant Corp., Washington, D. C., Federal agency. Executive offices of the company are at Nashville, Tenn.

Ga., Atlanta—Water Dept., City Hall, W. Zode Smith, general manager, plans extensions and improvements in River pumping station, with installation of new boilers, stokers, coal-handling machinery and accessory equipment. Cost estimated about $200,000. Application has been made for a priority rating.

Ill., Springfield—Water, Light and Power Dept, Monroe and 7th Sts., has plans under advisement for postwar expansion program at Lake Side municipal power plant, including installation of new generating unit, boiler and accessory equipment, reported to cost about $500,000.

Ind., Decatur—Kraft Cheese Co., Decatur, plans installation of electric power equipment in new one and three-story milk condensing plant, about 70 x 100 ft, on local site. Cost reported close to $100,000, with machinery. A priority rating is being secured. William A. Klepper is general manager of the Indiana Division, Decatur. Main offices are at 500 North Peshtigo Ct., Chicago, Ill.

Ind., Goshen—Electric Light & Water Works, West Lincoln Ave., plans extension and improvements in municipal electric power plant as a postwar project, with installation of additional equipment for increased output. Cost reported close to $175,000, with equipment.

Iowa, Indianola—Dept. of Municipal Utilities, Indianola, V. E. Knight, superintendent and city engineer, is considering extensions and improvements in municipal electric generating plant, including installation of new generating unit and accessory equipment. Estimates of cost are being made. It is understood that project will be a postwar development.

La., Lake Charles—Mathieson Alkali Works, Inc., Lake Charles, manufacturer of industrial chemicals, liquid chlorine, caustic soda, etc., will carry out expansion in local plant for production for Government, with additional buildings and machinery for considerable increased output. Electric power equipment will be installed. Cost estimated about $900,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency, which will hold title to property. Main offices are at 60 East 42nd St., New York, N. Y.

La., New Orleans—Stauffer Chemical Co., 420 Lexington Ave., New York, N. Y., manufacturer of industrial chemicals, acids, sulphur, etc., plans installation of electric power equipment in proposed new plant for processing and refining of sulphur, to be located in vicinity of New Orleans, where 20-acre site fronting on Mississippi River is being secured. A boiler house and pumping station will be built. Entire project is reported to cost over $400,000.

Md., Hagerstown—Municipal Electric Light Dept., City Hall, plans extensions and improvements in municipal power station, estimated to cost about $50,000, with equipment. Appropriation in that amount has been authorized in 1944 city budget.

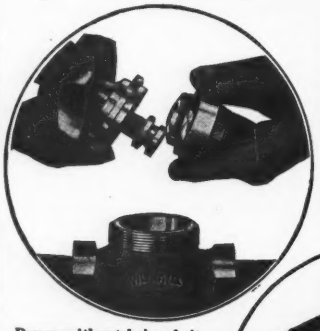
Mass., Concord—State Dept. of Correction, State House, Boston, Mass., has authorized plans for extensions and improvements in boiler house at institution at Concord, with installation of additional equipment, to be carried out as a postwar development. Cost reported close to $50,000. Charles T. Main, Inc., 201 Devonshire St., Boston, is consulting engineer.

Minn., Chisholm—City Council is considering preliminary plans for a municipal power plant as a postwar project, estimated to cost over $500,000, with turbine-generator and accessories, boilers and auxiliary equipment.

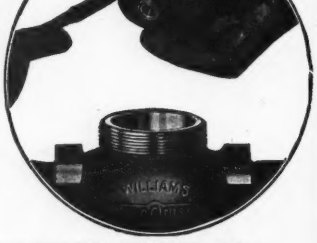
Miss., Hattiesburg—Mississippi Power Co., Gulfport, Miss., will re-

Use VULCODISC

for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.



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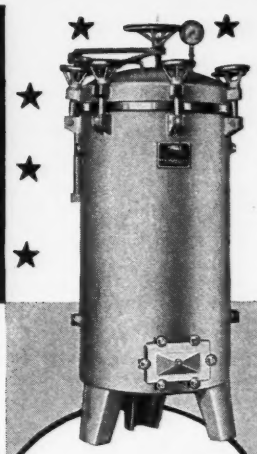

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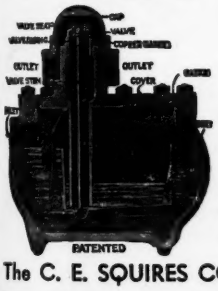

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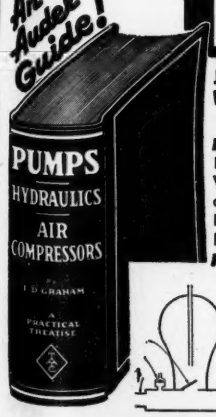

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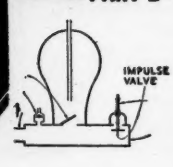

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sume work at once on construction of new Eaton steam-electric generating station on Leaf River, near Hattiesburg, to be equipped for initial capacity of 20,000 kw. Project will include extensions in transmission lines for connection with present high-tension system. It is understood that project will have a priority rating. Work was begun a number of months ago and later discontinued. No estimate of cost announced.

Neb., Columbus—Consumers Public Power District, Columbus, plans extensions in transmission and distributing lines in parts of Keith and Colfax counties. No estimate of cost announced. State permission has been secured and work is scheduled to begin soon.

Neb., Tekamah—Burt County Rural Public Power District, Tekamah, plans extensions in primary and secondary lines in Burt County, with service connections and other operating facilities. Cost about $60,000. Financing in that amount has been arranged through Federal aid and work is scheduled to begin soon. It is understood that project will have a priority rating.

N. Y., Ogdensburg—State Dept. of Mental Hygiene, State Office Bldg., Albany, N. Y., plans new power plant at Lawrence State Hospital, Ogdensburg, as a postwar project, reported to cost close to $960,000, with equipment. Also plans extensions and improvements in power plant at Letchworth Village, Thiells, with installation of additional equipment, to cost approximately $400,000.

Ohio, Bedford—Jack & Heintz, Inc., 17600 Broadway, manufacturer of aircraft starters and other airplane apparatus, has contracted with Government for expansion in plant, including additional buildings, with machinery for large increased capacity. Electric power equipment will be installed. Entire project will cost approximately $2,000,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency, which will retain title to property.

Ohio, Sidney—Monarch Machine Tool Co., Sidney, manufacturer of lathes, parts, etc., plans installation of electric power equipment in connection with expansion in plant for production for Government. Cost estimated about $630,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency, which will retain title to property. Work will be carried out soon.

Okla., Oklahoma City — Water Dept., City Hall, plans high service and low service pumping stations, with motor-driven pumping machinery and auxiliary equipment, in connection with new filtration plant at Bluff Creek, for municipal water system. Filtration plant will have a rated capacity of 12,000,000 gal per day. Entire project is estimated to cost close to $800,000. Application has been made for a priority rating.

S. C., Clemson—Deering, Milliken & Co., Inc., Church and Leonard Sts., New York, N. Y., operating rayon and cotton mills, has plans for immediate construction of new one and multistory rayon mill on 240-acre tract of land fronting on Seneca River. Electric power equipment will be installed. A power house is planned. Entire project will cost about $2,000,000 and will be carried out under direction of Excelsior Mills, Union, S. C., an affiliated interest, which will operate plant. A priority rating has been secured. J. E. Sirrine, 215 South Main St., Greenville, S. C., are architects and engineers.

Tenn., Chattanooga — Southern Chemical Cotton Co., Alton Park, Chattanooga, manufacturer of processed cotton products, plans installation of electric power equipment in new addition for production of chemical cotton pulp in sheet form for rayon tire cord service. Project has a priority rating and is estimated to cost about $300,000, with machinery. Work will begin soon. W. Donald Munson is president and general manager.

Tenn., Elizabethton—North American Rayon Corp., Elizabethton, plans large addition to mill for production of high tenacity rayon for tire cord manufacture. Electric power equipment will be installed. Cost reported over $750,000, with machinery. Work is scheduled to begin at once. Project has a priority rating. Moran, Proctor, Freeman & Muesser, 420 Lexington Ave., New York, N. Y., are consulting engineers. Executive offices of company are at 261 Fifth Ave., New York.

Texas, Fort Worth—Water Dept., City Hall, plans extensions in main waterworks pumping station, with installation of additional motor-driven pumping machinery and auxiliary equipment. Cost estimated close to $104,000. Financing has been arranged through Federal aid. Freese & Nichols, Capps Bldg., Fort Worth, are consulting engineers.

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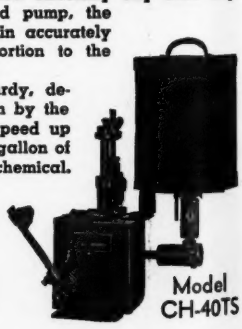

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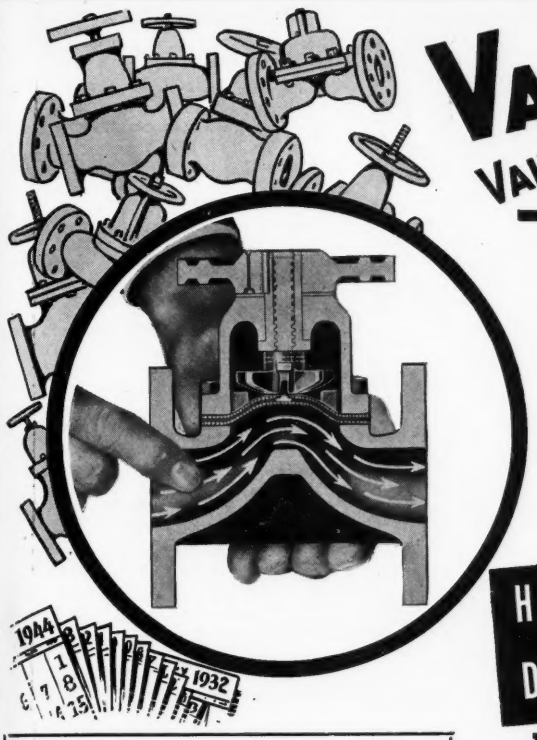

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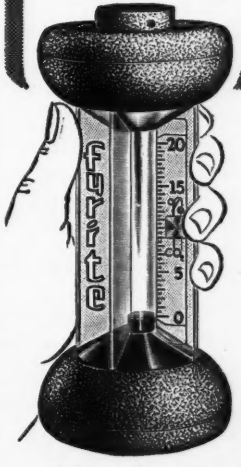

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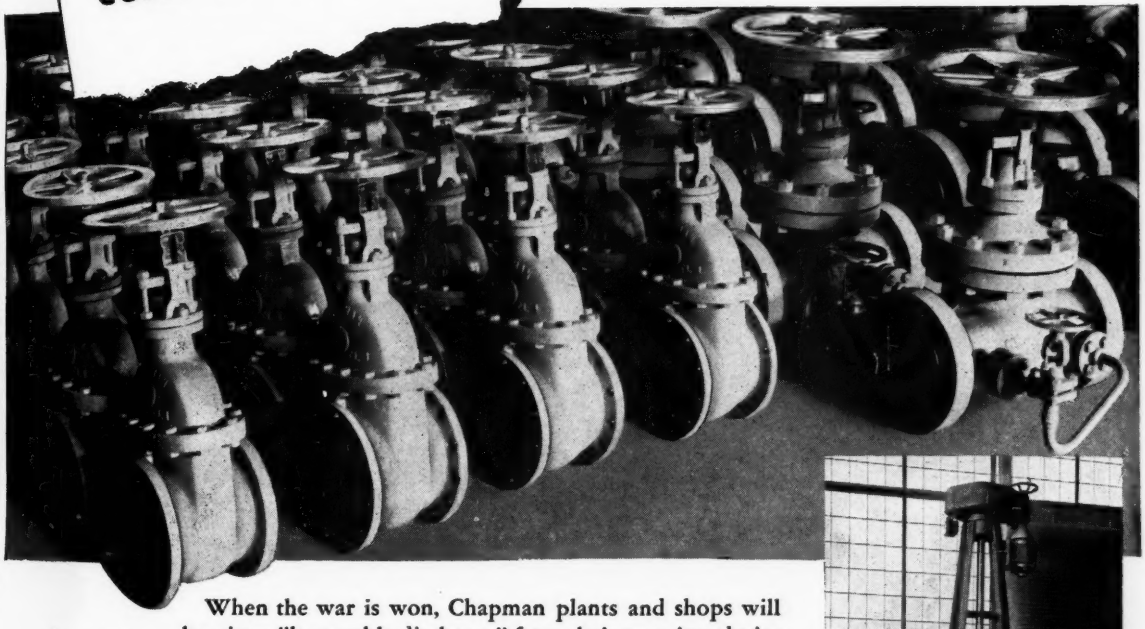

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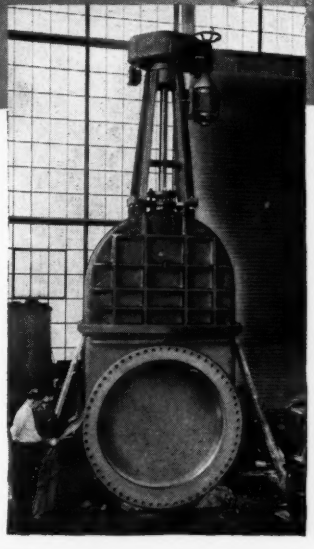

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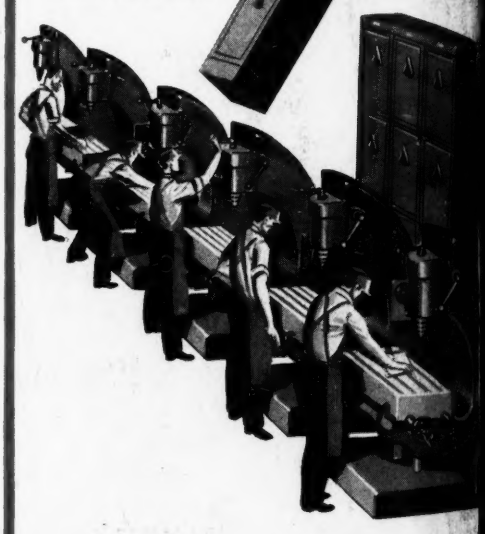

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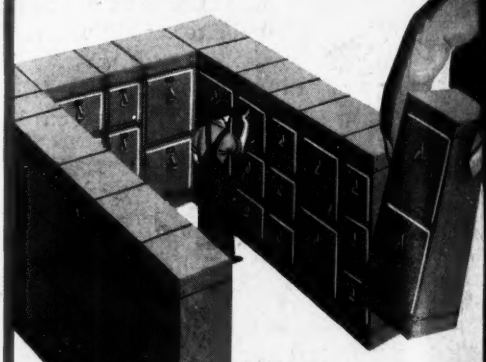

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